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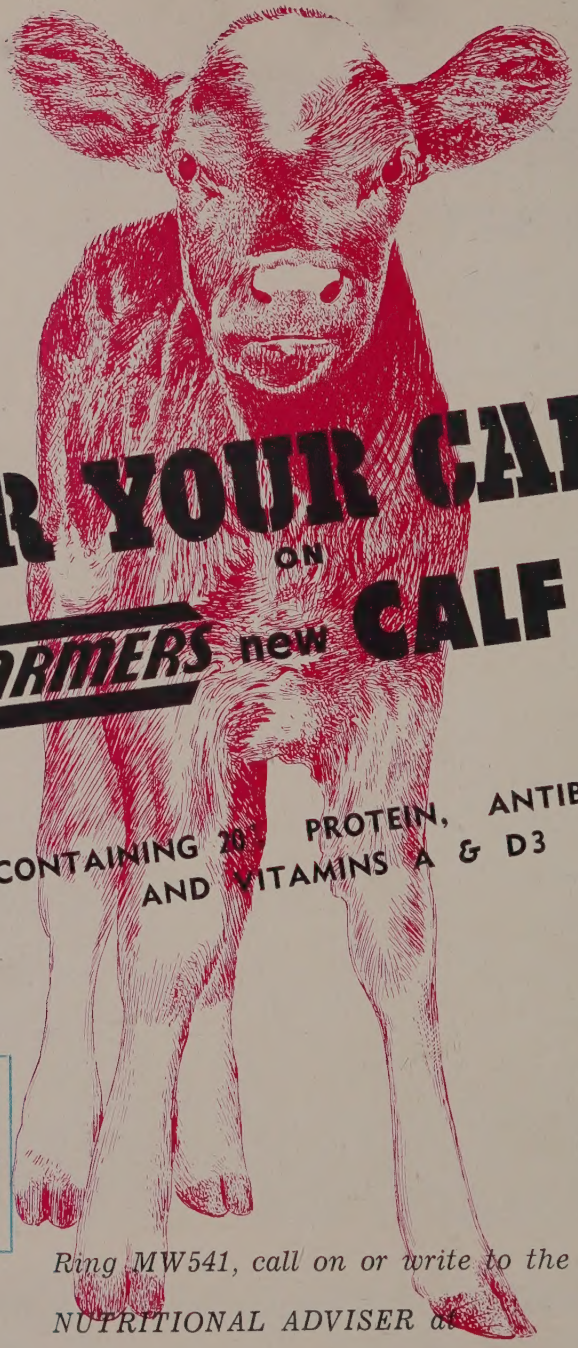

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The JOURNAL OF THE DEPARTMENT OF AGRICULTURE
WESTERN AUSTRALIA

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COVER PICTURE

The delicately-textured blue flowers of the Leschenaultia are a feature of springtime in Western Australia. The plant grows profusely in the Darling Ranges, but is probably seen at its best in the loamy soils east of Northam. It is named in honour of the botanist, Leschenault de la Tour, who accompanied Captain Nicholas Baudin on his voyage to Australia in 1802.

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CAPONISING COCKERELS

By D. K. GILES, Poultry Adviser, and R. VAGG, Poultry Instructor.

BECAUSE of its tenderness, succulence and delicate flavour, the flesh of the capon has long been held in high regard by epicures in many lands. Over three centuries have passed since Shakespeare wrote of the portly justice whose "fair round belly" was "with fat capon lined," but throughout the years capons have usually commanded high prices from discriminating consumers of table poultry.

Originally, a capon was a castrated cockerel— a bird from which the testes had been surgically removed causing it to become permanently sterile. Today, an effect similar to surgical castration may be obtained by using chemical compounds — synthetic female sex hormones— which suppress the male hormones normally secreted by the testes. While the male hormones are thus "blanketed," the cockerel shows marked female characteristics and resembles a bird from which the testes have been removed.

As a table bird, the capon has definite advantages over the entire cockerel. The carcass is usually plumper on the breast, the skin is softer and smoother, and the meat remains tender, juicy, and delicately-flavoured even if the bird is allowed to reach an age when the entire cockerel's flesh would be tough, stringy and strongly-flavoured.

In experiments conducted recently at the Poultry Research Station in this State, cockerels which had been chemic-

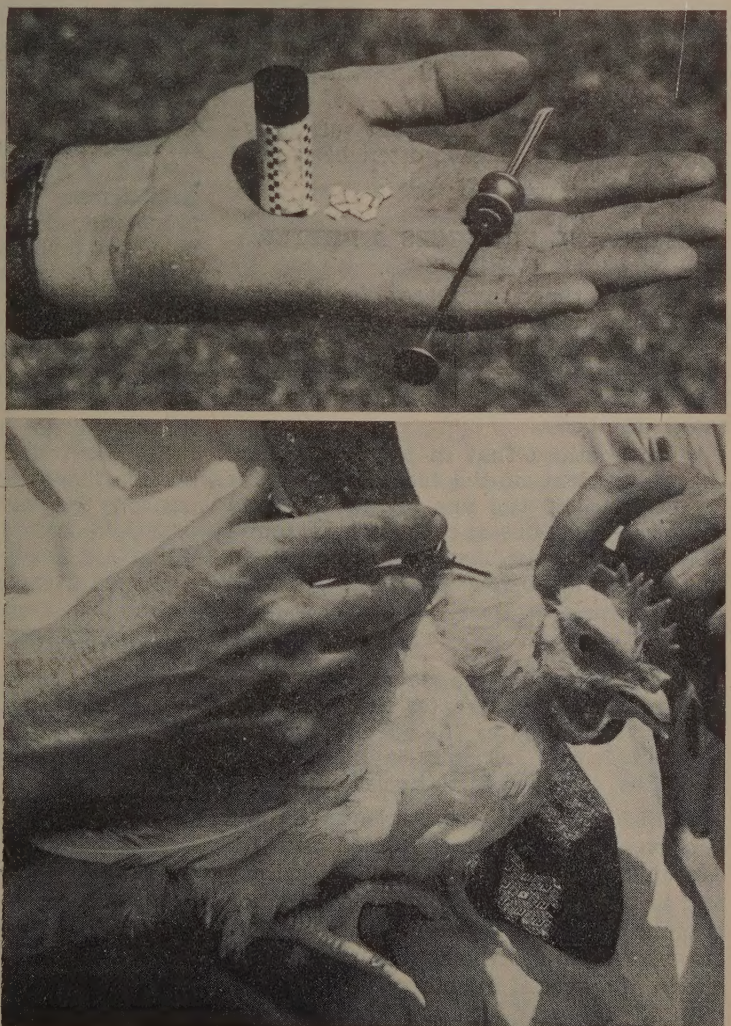

Fig. 1.—The top picture shows the outfit used in chemical caponising, the hexoestrol pellets and the pellet implanter. Below, the pellet is being inserted beneath the skin of the neck.

ally caponised with hexoestrol at the age of 12 weeks showed an eight per cent. gain in body weight at the age of 16 weeks, when compared with untreated birds of the same ages, fed and housed under identical conditions.

Birds which have been caponised either surgically or chemically, lose their aggressiveness and become more effeminate in appearance and conformation. In the chemically-caponised birds these effects are usually temporary, lasting only as long as the female sex hormone is available in sufficient quantity to suppress the male hormone. Once the level drops below this point, the cockerel's normal sex characters—and in most cases his fertility—may gradually be restored.

It is interesting to note that surgically-caponised cockerels have often been used to "mother" batches of chicks.

CAPONISING PRODUCES A BETTER CARCASS

For some time, the reason for the improvement in carcass quality from capons was not fully understood, but more recently investigations have shown that it is due to a difference in fat utilisation within the body.

It was noticed that in the laying hen, the fat content of the blood was always higher than in the non-laying hen and the cockerel. Subsequently it was found that this fat in the blood of the laying hen was used in the formation of the egg yolk. This led to the discovery that the blood fat level was as high in the surgical capon as in the laying hen, but in the case of the capon, most of the fat was diverted to abdominal deposits, while a small quantity was distributed in the body muscle. At the same time, the skin of the capons became much softer and smoother than in the non-capon. The muscular fat was responsible for the better flesh quality, and the improved skin texture enhanced the appearance of the carcass for market.

Changes, similar to those resulting from surgical caponising, may be induced by implanting synthetic female sex hormones in sufficient quantity to suppress the naturally-produced male hormones. This method of chemical caponising is rapidly becoming standard practice on many properties producing table poultry.

Another interesting feature of the artificial female sex hormone is that, when it is introduced into the non-laying hen, the blood fat level is increased to levels similar to those in the laying hen, as described above. In this case, there is no yolk to utilise this excess blood fat so that it has to be stored in the body in a similar manner to the capon. The introduction of an excess of this group of female sex hormones will not induce laying, this activity being controlled by another body mechanism. The use of female sex hormones to improve the carcass quality of hens is not practised commercially as any bird of either sex showing signs of age is invariably sold at a discount.

CHEMICAL CAPONISING

BECAUSE surgical caponising demands a fairly high degree of skill, takes more time and involves a greater risk of injury to the birds it has, during recent years, been largely superseded by the chemical method. In chemical caponising, a pellet containing the female sex hormone is implanted beneath the skin of the bird so that it is gradually absorbed into the system.

Stillboestrol and hexoestrol are the two hormones most commonly used and for convenience of treatment they are usually sold in pellets each containing a 15 milligramme dose of the drug. These pellets are inserted under the skin of the bird by means of a special injector.

While the consumption of excessive quantities of female sex hormones could have undesirable effects on some human beings, research indicates that very large quantities of capon meat would have to be consumed continuously to produce these ill-effects.

As a precaution against receiving excessive dosages, however, the hormone pellets are implanted in a part of the bird not used for human food—usually in the top of the neck just below the comb. This ensures that any residues are disposed of when the head is removed.

TIME OF TREATMENT

If cockerels are chemically caponised between the ages of eight to 12 weeks, a single pellet will usually suffice except when it is desired to carry the birds to a heavier weight than would normally be required. The marketing date is usually about four weeks after caponising.

Where heavyweight birds are required, it may be advisable to postpone the hormone treatment to the 12th week and then implant two or three pellets. As the bird grows older, the testes secrete more of the male hormone and consequently a larger dose of the female hormone is needed to suppress the male characteristics.

Where prices show a tendency to fluctuate an alternative would be to implant a single pellet between the ages of eight to 12 weeks and a second pellet later if it is desired to hold the birds until a more favourable market is assured. This of course would entail extra cost for labour and pellets. The treatment should in any case be carried out before the bird develops spurs. The carcass trade demands a bird without spurs, otherwise it is classed as a "stag."

IMPLANTING THE PELLET

The pellet containing the female sex hormone is implanted between the skin and the muscle by means of a special injector consisting basically of a hollow needle fitted with a plunger.

The pellet is placed in the needle and a fold of loose skin on top of the neck just below the comb is pulled away from the neck with the thumb and forefinger. About half an inch of the needle is inserted under the skin with the point directed towards the head. The plunger is pressed to eject the pellet and the needle is given a quarter-turn to ensure that the pellet is left in position when the injector is withdrawn.

DOSAGE

Hexoestrol is now preferred, as birds treated with this preparation usually show an increase in body weight. Most manufacturers supply pellets containing 15 milligrammes of hexoestrol which can be used in the standard injectors made for this purpose.

One pellet is a suitable dose for a cockerel up to 12 weeks old but two pellets may be required if the bird is older.

SURGICAL CAPONISING

OVER 2,000 years ago, Roman farmers used to surgically caponise cockerels to produce better table birds and it is believed that the Chinese practised a similar form of caponisation at an even earlier date. Today, despite the greater simplicity and rapidity of the chemical method, there are still a number of poultrymen who prefer to surgically caponise their birds. Although the operation requires some degree of specialised skill, the effects are permanent and the birds may be reared to any desired age and weight consistent with profitable marketing.

The caponising operation entails the removal of the testes which are situated inside the body cavity, one on each side of the backbone.

Sets of caponising instruments, which may be purchased from most suppliers of poultry requisites, usually include a scalpel or knife for making the first incision, a spreader for holding the ribs apart, a probe fitted with a hook for tearing the membranes enclosing the abdominal organs, and special forceps for grasping and removing the testicles. Weighted cords for restraining the bird during the operation are sometimes included, but, if not, these may easily be improvised.

The operation is not a particularly difficult one to perform, but beginners would be well advised to practise on dead cockerels until they are familiar with the anatomy of the birds and are able to carry out the work quickly and cleanly.

SELECTION OF BIRDS

Birds to be surgically caponised should be selected from healthy vigorous stock showing about half an inch of red comb development. At this stage, the testes will be about the size and shape of large plump grains of wheat. The degree of maturity, rather than the age, should be

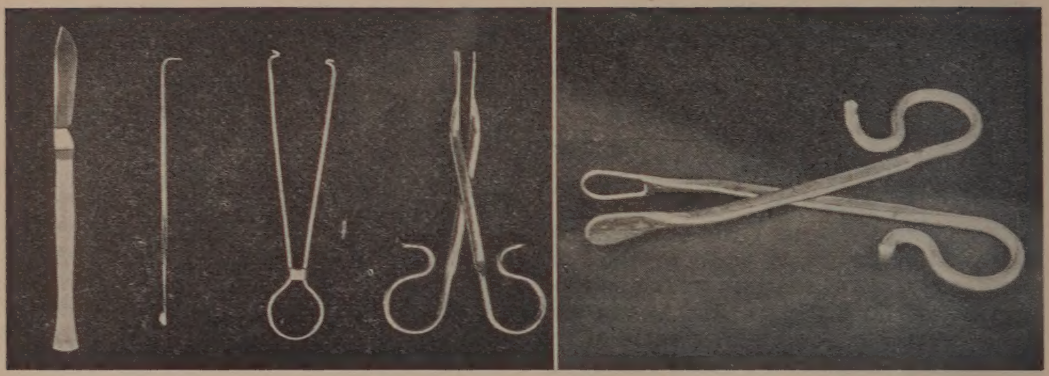

Fig. 2.—Instruments used in surgical caponising. Left to right—Scalpel; Probe with hook for tearing peritoneal membrane; Rib spreaders; Testicle-removing forceps; Forceps showing loop and plate on jaws.

the determining factor but this stage of growth is usually attained between the ages of six to eight weeks. Older birds may be caponised but the operation entails greater risks and the set-back to the birds' growth is correspondingly more severe.

PREPARATION

Food should be withheld from the birds for at least 14 hours, and water for six hours, prior to the operation. This ensures that the intestines are almost empty and have an opportunity to settle away from the testes and body walls, thus reducing the risk of punctures and affording a better view of the sex glands.

PERFORMING THE OPERATION

The bird is laid on its side on a box or small table. A weighted cord is attached to the legs by two half-hitches, or any simple easily-released knot, and a similar weighted cord is looped round the wings close to the body. The weights hang over the edges of the table or box so that they exert a slight pull in opposite directions

Fig. 3.—Bird in position for surgical caponising. The legs and wings are secured by weighted cords and feathers are plucked from the site of the incision.

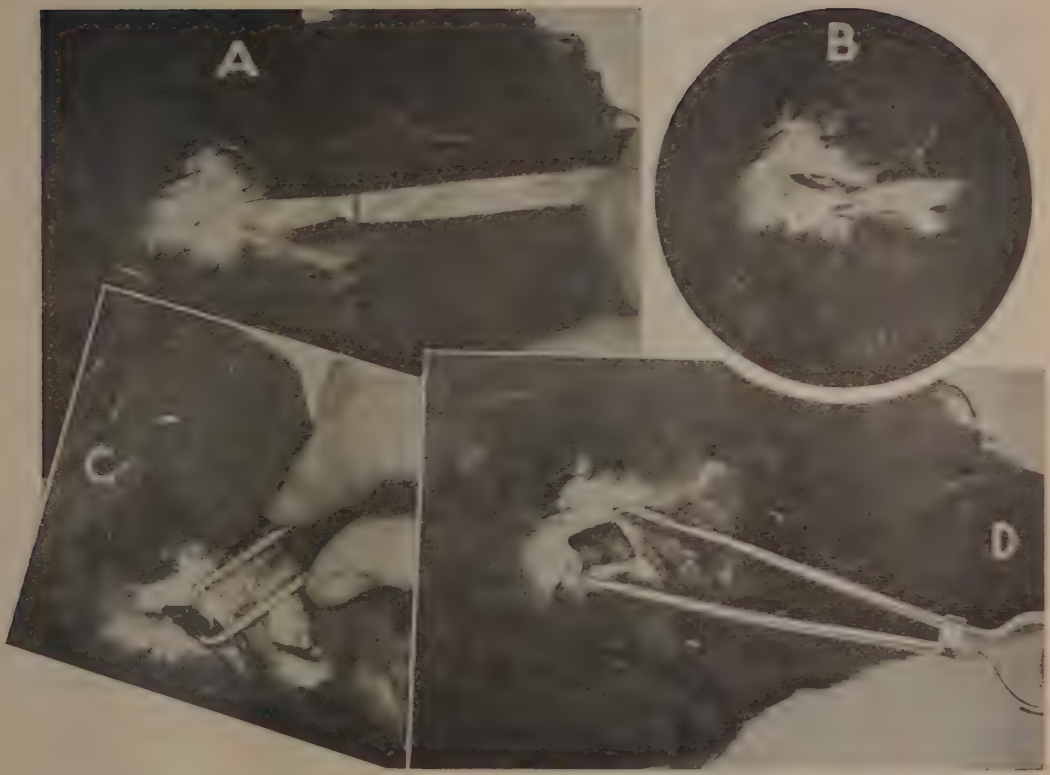

Fig. 4.—A,—Commencing the incision between the two last ribs; B,—The incision completed; C,—Inserting the rib spreader; D,—Spreader in position.

(See Fig. 1). Weights of about 1 lb. each should suffice as they should be only heavy enough to hold the bird securely without undue stretching of the body.

Pluck the soft downy feathers from a space between the hip and the rib. Moisten the remaining feathers if they persist in getting in the way.

Now place the middle finger of the left hand on the bird's hip and draw the skin towards the head. While still holding the skin taut, feel for the two ribs nearest to the hip, using the forefinger of the same hand.

The incision is made between these two ribs. If made between the second and third ribs from the hip, there is a risk of injuring the lungs. If made between the last rib and the hip the incision is too far back for easy removal of the testes, and may cause injury to the leg muscles.

Making the Incision.

Stand facing the breastbone of the bird. Having drawn the skin towards the left, or head of the bird and located the space between the last two ribs with the left forefinger, press the point of the knife firmly through the skin and flesh at a point between the ribs and not less than ¾in. from the backbone.

If the birds have been deprived of food as previously recommended the knife point can enter the body cavity to a depth of ¼in. without risk of puncturing the intestines.

The knife should be held with the cutting edge towards the operator and the handle sloping away from him.

Cutting towards the operator and slightly upward, the incision should be lengthened to about 1¼in. by a firm confident cut.

Fig. 5.—E—Inserting the forceps; F—Testicle held between jaws of forceps; G—Testicle removed by twisting and gentle traction; H—The operation completed and the spreader removed.

The spreader is inserted with one hook round each rib and the wound is gradually widened until the opening is ½in. to ¾in. across. The spreaders are locked at this point.

The abdominal cavity is lined with a delicate, glistening peritoneal membrane and the hook end of the probe is used to tear this open to expose the testes and intestines.

The upper testicle should now be easily visible as a light-coloured, elongated organ about the size and shape of a plump grain of wheat. The lower testicle lies in a corresponding position on the opposite side of the backbone, and it is advisable to remove this first so that if any bleeding occurs, the site of the operation will not be obscured.

The spermatic artery is located just behind and attached to the testicles and if this artery is ruptured, the bird will bleed to death.

With the testicle forceps closed, reach under the backbone slightly to the rear of the upper testicle and lift the lower testicle into view. Do not press hard against the backbone as this causes unnecessary suffering to the bird.

Still exerting a slight upward pressure, open the jaws of the forceps slightly and allow the testicle to slide over the upper jaw and rest on the lower jaw. Close the jaws to give merely a holding pressure, move them from side to side a few times to allow the blood-vessels to slip out, then close the jaws firmly and twist the forceps with a gentle pulling motion until the testicle comes free.

Once the lower testicle is removed, there should be much less difficulty encountered in freeing the upper testicle which is much more accessible.

If, as occasionally happens, it is very difficult to locate and remove the lower testicle, leave it in position and remove the upper one only. When this is completed, turn the bird over and make a second incision on the other side, through which the testicle can usually be removed without difficulty.

Some operators always make the two incisions, but to save time and avoid unnecessary injury to the birds it is better to remove both testicles through the one incision wherever possible.

AFTER CARE

When the operation is completed and the bird released, the skin should slide over the cut and no further attention should be necessary.

Birds should be placed in a warm shed with food and water immediately avail-

able. As flying or jumping may delay healing, the feed hoppers and water vessels should be at ground level and perches should be low or may be dispensed with altogther.

A proportion of the birds may develop "wind-puffs" after a few days. These swellings are caused by air being trapped under the skin near the site of the operation. They are treated by piercing the skin over the swelling with a clean, sharp-pointed instrument and allowing the air to escape.

Infection of caponising wounds is rarely encountered and in most cases complete healing is achieved in about ten days.

Book Review.

A DIRECTORY OF SCOTTISH AGRICULTURE

PASTORALISTS and farmers of Scottish ancestry, and those who contemplate a visit to Scotland in the near future, will find much that is interesting in "The Annual Farming Digest and Agricultural Directory of Scotland"—the 1956 edition of which recently came to hand.

In addition to a number of short articles on various phases of Scottish agriculture, the Directory contains some well-produced photographs of Scottish beauty spots and a mass of useful information of interest to farmers all the world over.

For livestock owners there are notes on the origins and development of many breeds of cattle, horses, ponies, sheep and pigs together with a description of their show points. A list of breed societies, pedigree stock-breeders and descriptions of some notable stud stock farms make this section a particularly valuable help to the tourist from overseas.

Details of Government departments, marketing boards, research and educational institutions, Chambers of Commerce, show societies and agricultural organisations as well as business and professional associations are included in the Reference Section and there is a comprehensive buyer's guide, listing the classified trades in each county.

For the women folk there is a feature on Scottish cookery describing the preparation of such dishes as Scotch broth, lang kail, cullen skink, potato soup, "tatties an' herrin,'" Forfar bridies; Pitcaithly bannock, potato and oatmeal cake and a host of other recipes.

A comprehensive index makes for easy reference to the mass of information contained in the 408 neatly-printed pages.

"The Agricultural Directory of Scotland —1956 Edition" is available from the publishers—Mearns Agricultural Publications, 7-9 Union Row, Aberdeen, Scotland and the price is 10s. 6d. sterling.—J.M.

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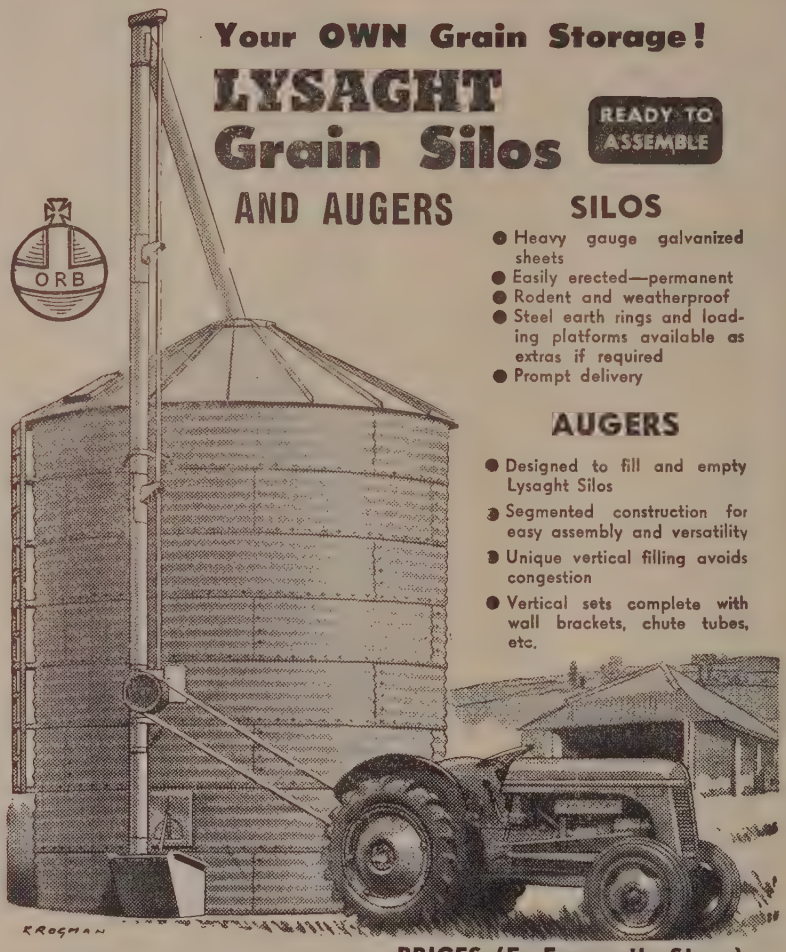

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Fig. 1.—An excellent stand of lucerne grown under sprinkler irrigation on a dairy farm near Perth.

LUCERNE GROWING IN WESTERN AUSTRALIA *

By H. G. ELLIOTT, Assistant Superintendent of Dairying

LUCERNE is one of the oldest of the cultivated forage plants, and is one of the most important agricultural crops known to man. Although it gives best results where ample water is available, it flourishes under semi-arid conditions and will grow well almost wherever cereals can be profitably produced. Besides being one of the hardiest of the known agricultural crops for hot dry conditions, it is one of the most palatable and nutritious foods for livestock including all farm animals and birds, as they can maintain themselves and thrive on it.

The crop has been cultivated for centuries in the semi-arid portions of Asia, as well as in parts of Europe, and in all places it produces an abundance of fodder of the highest quality, improves poor soils and assists in eradicating weeds. This plant can be successfully grown on a variety of soils, which range from loose sand to relatively heavy clay loams.

DESCRIPTION OF PLANT

Lucerne (*Medicago sativa*)is a perennial plant belonging to the family of *Leguminosae,* of which it is probably the best known and most valuable member. The plant is either covered more or less with soft hairs, or is smooth. It grows from 1ft. to 3ft. in height, producing fairly upright stems, with many branches and much foliage. The stem originates from the crown at the summit of the tap-root, which is situated above or at the surface of the ground. The leaves, which are arranged alternately on the stems, consist of three leaflets, which in all types are wedge-shaped, but vary considerably, some being relatively long and narrow whilst in other varieties they are short and rounded. All leaflets are toothed at the summit.

The flowers, which in different varieties may be any shade of violet, from very pale to deep reddish purple, are small and typically pea-like in shape, and are arranged in loose clusters at the summit of

* Revised from Leaflet No. 634.

each branch. There are from two to six kidney-shaped seeds of a yellowish green colour in each pod, and they are about ⅛ of an inch in length, the pods being spirally twisted in two to four loose coils, open through the centre.

Lucerne is a deep-rooting, remarkably long lived and prolific perennial. Under the best conditions it may be cut many times a year, and year after year. It has been stated that there are lucerne fields in Mexico over 200 years old, and there are in France fields which are known to have been in production for over a century. There is no reason to believe that it will not be equally long-lived in Australia, if established on suitable soils, efficiently manured and given reasonable attention.

The tap-roots of the lucerne plants penetrate readily to 10ft. to 20ft., and have been traced to much greater depths. Lucerne roots have been found 30ft. below the surface of the alluvial flats of the Hunter River. Coburn records a case where the roots were found penetrating through crevices in the roof of a tunnel 129ft. below the surface of the lucerne field. This extraordinary growth of the roots of a plant which normally does not exceed 3ft. to 4ft. in height, shows that there are often differences between the habits of lucerne and other cultivated plants, and this points to the advisability of giving careful consideration to the soil conditions before attempting lucerne cultivation. It will go down to food and water if it can, and it is the farmer's business to see that it can.

It can be stated that the lucerne is one of the hardiest of the cultivated crops. Where dry and hot conditions prevail it will produce more growth than any other known perennial plant. Except at the time of seed germination, lucerne does not require much moisture near the surface, and flourishes with sunshine in hot summer temperatures. For most prolific growths, lucerne requires a well-drained deep soil, which is not acid and contains plenty of moisture, either supplied from underground, or supplemented by irrigation, ample phosphatic fertilisers, and thorough cultivation during the life of the crop.

CLIMATE

Lucerne loves heat and makes its maximum growth in the spring and summer. It is at its best with plentiful supplies of water in combination with heat. Under such conditions, which in this State usually involve irrigation, it is remarkably prolific, successive cuttings of luxuriant forage being obtained at intervals of five to six weeks with an aggregate yield per acre of 20 to 25 tons of green fodder, or if made into hay of six to eight tons. Owing to its deep rooting system, it is well able also to withstand extremes of temperatures. It is well adapted to withstand summer drought, and when sufficient water is available and good management is practised. lucerne gives its maximum return.

SOIL

Except under adverse conditions, lucerne is not particular as to soil. With suitable treatment it will grow on almost all classes from nearly pure clay to light, sandy soils. At one time it was thought that it would only grow on rich, deep, alluvial types, but experience has shown that there is hardly any kind of soil on which it will not grow providing it is not acid or waterlogged. The most favourable one is a rich, somewhat sandy loam, warm and friable.

Good drainage is the essential requirement of the lucerne plant, and waterlogged soils are useless for the crop. In naturally wet land, or land made so by the incorrect use of irrigation water, lucerne is very apt to take on a sickly yellow appearance. Under these conditions, weeds will become a severe competitor with the lucerne crop. It is well to remember that lucerne will not stand wet feet. Consequently, if the soil is not naturally drained to a depth of several feet, action must be taken to bring about this condition before lucerne is planted.

PREPARATION OF SEED BED

Lucerne likes a compact, well prepared seed-bed with just a little loose soil on the top. Although lucerne, when established, is one of the hardiest of plants, yet when young it is delicate, and requires favourable conditions for its support.

Fig. 2.—Cattle grazing on sprinkler-irrigated lucerne at Carnarvon.

In some of our drier areas it has been found that a cloddy surface seed-bed is advantageous when establishing young lucerne plants, more particularly where spring planting is adopted. Except in rare instances, the ploughing should not be done later than at least six weeks before the seed is to be sown, for if ploughed later than this, it is difficult to get the seed-bed into that compact condition which is so essential for the best results in the establishment of this crop. The planting of the seed in a loose seed-bed is a frequent source of failure with a lucerne crop.

It is also desirable to have the seed-bed very free from weeds and weed seeds, as these are a big problem in the establishment, for they will often kill or smother young lucerne seedlings, owing to the slow initial growth of the latter. This condition is the most frequent cause of failure of young lucerne stands. Where autumn planting is carried out, it is necessary that the land be properly bare fallowed, firstly to assist in controlling weeds, and secondly to assist in controlling such pests as lucerne flea and red mite. To do this it is essential that no weeds of any kind be permitted to grow.

TIME OF PLANTING

Lucerne can be seeded either in the autumn or in the spring, but the time of sowing will vary with a number of conditions. In warm areas and particularly the dry districts of Western Australia, autumn sowing, i.e. March or April, is likely to give the best results, provided the weeds and insect pests can be controlled. Rain usually falls then and the ground is warm to ensure good germination of the seed and a vigorous growth of the plants. During the winter, plants have opportunities to make good root growth, so that they become strong enough to stand the hot weather of summer. On the other hand, in cool districts with a liberal rainfall, or where weed growth, red mite and lucerne flea are troublesome, spring sowing is advisable. Where spring planting is practised, the ground should be fallowed in the autumn or winter to assist in combating pests and weeds. If the areas are to be irrigated, the seed can be sown whenever convenient to the farmer. Generally the best results would be obtained from autumn planting.

SEED

It is well known that a good seed-bed is essential for success, but the time and trouble expended on the preparation of it may be wasted by the use of poor seed, as good stands cannot be expected from such. Only seeds that are plump, bright yellow in colour, free from hard dark brown, shrivelled or immature seeds, and free from weeds should be used. Old seed is usually dull and dark in colour, as the brightness soon fades with age. Immature seed, is generally green instead of bright yellow in colour, even when not shrivelled. Germination tests of the seed prior to sowing are advisable, but still may not give a true index when sown into the soil.

VARIETIES

There are several kinds of lucerne. These are, however, types rather than varieties, and are mainly of localised character and usually distinguished by the name of the country in which they have been grown, e.g. Peruvian, Turkestan, Arabian, African, etc. Many of these have been tried in Australia and the results obtained are to the effect that none is as suitable for, or as prolific under Australian conditions, as the Australian type, which has been evolved as the result of the survival of the fittest.

Good seed of the right kind is essential, and therefore the grower should see that he obtains it by using Australian-grown seed. Realising the superiority of seed produced in the Commonwealth, the Federal Government insists that all imported seed shall be stained pink, so as to make it readily distinguishable from the local seed, which in colour ranges from green to purple. Seedsmen are required to guarantee the germination and the maximum percentage of weed seeds and impurities in the sample offered. A good sample should have a germination of about 80 per cent., and should not contain more than one per cent. by weight of weed seeds and of impurities. The sale of lucerne containing dodder and other noxious weed seeds is absolutely prohibited.

RATE OF SEEDING

The quantity of seed to sow per acre depends on the quality of the seed, the method of sowing, the nature of the soil, the firmness of the seed-bed, the district in which it is planted, and the purpose for which the crop is intended. Consequently, no general recommendation can be made. For hay-making purposes, the quantity sown by farmers ranges from 6 to 25 lb. per acre. If, however, it is intended that the crop shall be grazed, the quantity sown is much less and ranges from to 2 to 8 lb. per acre.

Generally speaking, in the South-West, if the seed is to be sown in drills, 6 to 8 lb. per acre will be found satisfactory, but if broadcasted, 10 to 12 lb. would be required for good results. Under irrigated conditions, 15 to 25 lb. of seed per acre is recommended. In the wheatbelt a rate of 2 to 6 lb. per acre should be used when sown in drills. All the rates of seeding mentioned for different conditions depend upon obtaining good seed and having good soil conditions before sowing, otherwise the rate of seeding per acre must be increased.

METHOD OF SOWING

Except on loose, drifting sands lucerne need not be sown with a nurse crop. There is a general agreement among experienced lucerne growers that if lucerne succeeds with a nurse crop it is in spite of the additional drain upon the soil moisture instead of by reason of it. This is particularly applicable to dry climates, for when there is only a limited supply of moisture available, all this will be required to germinate the seed and give the young plant a vigorous start in life.

The seed is usually broadcast and should be sown near the surface. The seed may be broadcast either by hand, by a hand broadcasting machine of the "Cahoon" or similar type, or through the grass seeding attachment of the ordinary grain and fertiliser drill. An even distribution of seed is desirable; it is not easy to obtain this by broadcasting with such small quantities of small seed. The seed can be sown down the seed box of the grain and fertiliser drill if mixed with some bulky material like bran. It is sometimes mixed with superphosphate and sown through the fertiliser box, but this method is not recommended on account of the probable destructive action of the fertiliser on the vitality of the seed.

When sowing the seed through the "shoes" of the grain drill there is some risk that the seed may be planted too deeply, but provided the risk is known it can be guarded against and avoided. When sown down the tubes of the grain drill the seed can be deposited on the surface by removing the tubes from the "shoes" and at the same time a broadcasting effect can be obtained by arranging for the seed to be dropped on to a sloping board fixed with an inclination of about 30 degrees to the ground.

The seed is sometimes sown in drills which are far enough apart to admit of intertillage. This method is believed to be

the best for dry districts, and particularly for places where weeds are troublesome and for small patches.

INOCULATIONS

This is most essential for successful lucerne growing and it is recommended that, prior to sowing, the seed should be inoculated with the correct strain of nitrogen-fixing bacterial culture. These cultures can be obtained in a dry powder form from recognised seed merchants. Full instructions on how to use these cultures are given on the container.

MANURING

Lucerne is a heavy feeder. Under suitable conditions 20 tons of green crop may reasonably be expected in a season, and this would contain about 340 lb. of nitrogen, 60 lb. phosphoric acid, and 250 lb. potash. Fortunately, except during the period immediately following germination, this plant is not usually dependent upon the soil for its nitrogen supply. Being a legume it can, when suitable bacteria are present, obtain all its requirements in this connection from the inexhaustible supply contained in the air. But the phosphoric acid and potash must be obtained from that already in the soil or from fertilisers applied to the soil.

On fertile loams it may be assumed that the soil will contain sufficient nitrogen to meet the requirements of the young lucerne plant, and supply its needs until the necessary bacteria are sufficiently plentiful to enable it to secure all it needs in this connection from the air. Because the young plant requires to obtain its early nitrogen requirements from the soil, a small application of nitrogenous manure —sulphate of ammonia, blood, or nitrate of soda—is, however, recommended for sandy soils or others deficient in nitrogen-forming material. Guided by experience in the Eastern States, it is unlikely that, except in sandy soils, potash manuring will be necessary in the early stages, but it is equally likely that manuring with phosphoric acid will be followed by marked beneficial results. An application of from 2 to 3 cwt. of superphosphate per acre is recommended on all soils, even the best.

On loams poor in organic matter it will be advisable to supplement the superphosphate with an application of sulphate of ammonia up to 100 lb. per acre, so as to meet the nitrogen requirements of the plant until it is sufficiently established to obtain what it needs from the air. On such soils the fertiliser recommended is therefore:—Superphosphate 3 cwt. per acre; sulphate of ammonia 1 cwt. per acre. The fertiliser recommended per acre for sandy soils or those deficient in plant food is a complete one consisting of, say, sulphate of ammonia 100 lb.; superphosphate 400 lb.; muriate or sulphate of potash 400 lb.

Except in unusually rich soils it will be necessary to fertilise the crop annually. Subsequent applications of fertilisers should be governed largely by the returns aimed at or secured. It the soil is not rich enough for its latent fertility to be drawn upon, or if it is desired to replace the plant food removed by the crop, then an application of superphosphate 14 lb., sulphate or muriate of potash 25 lb., is recommended for every ton of green lucerne removed.

LIME

On sour and sandy soils a dressing of air-slaked lime or ground limestone at the rate of 20 cwt. per acre is recommended as a preliminary dressing to be applied at least one month before the seed is sown. This will have the effect of correcting acidity and stimulating bacterial activity.

TREATMENT AFTER SOWING

Even in the best prepared soil, weeds are likely to spring up, for most soils, and particularly old and fertile ones, contain dormant weed seeds, and these germinate with the lucerne seeds and become a menace to its success. It is not possible to cultivate the ground to destroy the weeds which may grow amongst the recently-planted lucerne, for in its young state it is so delicate and with so little roothold that even a harrowing is likely to pull out or damage a considerable number of plants. Lucerne planted in the autumn will rarely be strong enough to be cultivated before the following spring, or

Fig. 3.—Typical plant of Australian lucerne showing erect growth, vigorous rooting system, and freedom from excessive branching.

Fig. 4.—Lucerne hay in "cocks".

that sown in spring before the following autumn. Short of hand pulling, which is only possible on small areas, the most practical method of controlling weeds in young lucerne is to mow or graze them. If this latter plan is followed the grazing should be done with small stock and as quickly as possible.

The mowing can be commenced when the lucerne plants are four or five inches high, and repeated after a short interval, say, a month. This mowing, though detrimental to weed growth, will not injure the lucerne, but rather will stimulate it. Usually the material from the first mowing will not be worth gathering, and it can therefore be left, with advantage, to mulch the ground. As the object of this mowing is to destroy the weeds it should be undertaken whenever they are plentiful enough to warrant it, irrespective of the condition of the lucerne plants and the necessity for utilising the crop. It is emphasised that mowing does **not** injure but **stimulates** lucerne.

When the young plants have a firm roothold, and this can be determined by pulling at them, cultivation of the soil can take place with advantage. Its effect will be to stimulate the crop by letting air into the soil for the benefit of the nitrogen-fixing bacteria, and by conserving the soil mixture. For the first cultivation a light harrow is probably the best implement to use, but, as the lucerne gets older, much stronger implements, such as the spring-tooth cultivator or disc harrow can be used. One of the best implements for the purpose on established lucerne—over two years old—is the disc harrow. To one not accustomed to its use it may be thought that it will destroy the lucerne as well as cultivate the soil. This, however, is not so. The discs should not be given too much angle, and they will then split the lucerne crowns and cause them to throw up additional stems.

When the soil of an established lucerne bed becomes hard it can be disced and cross-disced to loosen it up with most beneficial results. There need be no fear that surface cultivation will kill the plants, as they are too deeply rooted to be injured, and the splitting of the crowns is beneficial. Discing and cross-discing is extremely useful should the paddock unfortunately become infested with couch grass.

HAYMAKING

Lucerne is much more difficult to make into hay than the cereals. This is because of the very sappy character of the stems, which do not dry as readily as the leaves. These latter are the most nutritious part of the plant, and if they become very dry are likely to fall off the stem during the operations of haymaking. The methods to be adopted should therefore aim to keep the leaves limp as long as possible, as whilst in this condition they will be drawing sap away from the stems very effectively. In practice the hay is made as far as possible in the windrows or in heaps or "cocks."

Lucerne may be cut at any time for green feed, and it may be accepted as an axiom that it is better at all times to cut early than late. Some farmers commence to cut the crop for hay shortly after the first flowers have appeared, others when the lower leaves begin to change colour. After flowering the food constituents are

transferred to the upper portions of the plant, the stems harden and become less digestible than when younger; further, some of the leaves wither and drop off and this results in loss of weight. Deferred cutting leads to poorer growth in the succeeding crop and may also result in a lessened number of cuttings during the season because of the greater time which the respective cuttings occupy the land.

Fig. 5.—Left: Nodules on lucerne roots. Right: The nitrogen-fixing bacteria (greatly enlarged).

Lucerne is usually mown and it should be cut as close to the ground as is possible without injury to the blade, so as to get the maximum amount of material and to force the new growth from the crown instead of from the joints of the old stems. The usual practice is to start when fine, bright weather is expected and as early in the morning as is possible, but not until any dew which may have been deposited has evaporated. It is not desirable that the cut material be allowed to remain in the swathe too long, especially if the weather is hot, for extreme heat causes rapid drying of the leaves, and these are likely to fall off during the subsequent operations. If it is allowed to remain just long enough to wilt during bright, fine, warm weather, this will take only a few hours, whereas with cool moist conditions it may take as many days.

After being wilted the material should be raked at once into windrows. If the day is a bright sunny one and the mower has been started in the morning, the rake can be started at midday, and should catch the mower before night. The next morning the material in the windrows can be placed into heaps or "cocks," and if the weather remains favourable it is probable that the lucerne will be fit to stack the following morning.

Sometimes during hot weather the curing is completed entirely in the windrows, which should be made loose so as to admit the air freely, but in cool, damp weather it will be advisable to place the material in "cocks" and allow the curing to finish in them. When dry enough or "cured," the hay is ready to be carted for stacking or baling. This is determined by an examination of the stalks, which need not be dry and brittle, but tough, though without any sap being noticeable when the stems are twisted tightly.

Just before carting the "cocks" are sometimes turned over to expose the bottom hay for an hour or so to the sun, so as to dry off any hay that may be slightly damp owing to its proximity to the ground. Sometimes in very hot weather the hay becomes too brittle as the day advances, and there is a danger of losing the leaves, and the carting has to be confined to the mornings.

GRAZING

It is generally recognised that considerable damage can be done to a lucerne stand by indiscriminate grazing, consequently every care must be taken to obtain best results without injury to the plant, to see that the crop is well established before grazing, and that the area is not overgrazed. The best height for grazing is about 1ft. and grazing should be controlled so that it is carried out rapidly.

Care should be taken when grazing stock on lucerne that they are not let in when it is wet, either by rain or dew, or when they are very hungry. Hoven, or bloat, is likely to be caused by feeding this succulent feed to hungry stock. The

danger is greatly increased when the plants are wet. When cattle are being introduced to this crop after a spell away from it, it is advisable to ensure that they are well fed first so that they will not be able to consume great quantities, or, if this is not possible, to turn them in for 30 minutes and take them off, letting them on again for a similar period a few hours later. They soon become accustomed to the crop, and will be able to remain in the crop without danger. However, it must be said that grazing, whatever its advantages, materially lessens the life of a stand.

SUMMARY

(1) Lucerne has been grown for many centuries and consequently is well known in most of the agricultural countries of the world. As far as can be ascertained it was introduced into Australia just after the first settlement by white men and since that time has made considerable progress.

(2) Lucerne flourishes in semi-arid climates, but for maximum growth requires abundant water during the summer months. Consequently, it grows best where supplemented with irrigation.

(3) Of the many varieties of lucerne, the most important in Western Australia is Australian Hunter River.

(4) For best results only high quality seed should be used.

(5) Lucerne has many peculiarities and troubles, being somewhat delicate when young, and of all crops is the most sensitive to competition from other plants, consequently the secret of success is to keep down weeds during the first year.

(6) Lucerne will not tolerate soils which become water-logged.

(7) This plant does not need, as many assert, abundance of lime in the soil, but freedom from acid is essential. Soils that are deficient in lime, however, should receive applications of agricultural lime prior to the planting of the lucerne.

(8) Inoculation of the seed with the necessary nitrogen-fixing bacteria prior to planting is essential.

(9) The ideal seedbed for lucerne should be firm, but with a fine tilth to a depth of 1½ inches.

(10) The best fertilisers are superphosphate and potash, the rates of application per acre varying according to districts.

(11) The land must be weed-free, for these are difficult to eliminate once the crop is sown.

(12) The best method of seeding is by drilling the seed into the land, but the seed should not be sown to greater depth than ½ inch.

(13) The best time to sow in this State is in the autumn or spring. In the South-West, spring is probably the best time, as it allows time for late cultivation to kill weeds, and lucerne flea and the red legged earth mite are easier to control.

(14) According to districts and methods of planting, the seeding rates may vary from 2 lb. to 20 lb. per acre.

(15) Cover or nurse crops are not recommended or required.

(16) Farmyard manure stimulates lucerne, but should always be well rotted prior to application and not applied heavily.

(17) When seed is sown in drills, the width between drills is determined by the weed difficulty. In the wheatbelt normal drill widths are recommended. In the South-West closer planting is preferred.

(18) If the first year stand is thin, the weak patches should be re-seeded while the plants are young, otherwise it is difficult to make an even stand.

(19) Lucerne produces very heavy crops of fine-textured forage, rich in protein, lime and other minerals, and is suitable for all classes of livestock.

(20) For best results good stands of lucerne should be cut and not grazed. Under this system of management the stand will persist much longer.

(21) Experience shows that the plant, once established, can be heavily harrowed and cultivated to reduce weeds and to mulch the surface soil.

(22) The time to cut lucerne for hay is when the new shoots have started from the crowns. This usually coincides with the flowering period.

(23) Lucerne leaves have a much higher value than the stems. Consequently great care should be taken, when harvesting, to ensure that all the leaves are saved.

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LEPTOSPIROSIS (Redwater) IN CALVES

BY C. R. TOOP, B.V.Sc., CHIEF VETERINARY OFFICER.

A DISEASE of calves with symptoms of fever accompanied by anaemia and jaundice and the passage of reddish-brown urine has been known to occur in Western Australia for many years. This disease is commonly known as redwater and it has been responsible for heavy mortalities in the dairying districts of the South-West. It may also affect adult cattle but the cases are usually sporadic and outbreaks are infrequent and such losses as do occur are associated with reduced production rather than mortality.

The disease is caused by bacteria known as leptospirae from which it derives the name leptospirosis. There are many species of leptospirae but in all of the outbreaks investigated in cattle in Western Australia *L. pomona* has been incriminated.

When the disease makes its appearance for the first time on a property it can usually be traced to the introduction of "carriers"—either cattle or pigs. Infection takes place both through the mucous membrane of the mouth and through scratches and abrasions on the skin and it is spread by the urine of infected animals. Calves or cows which have recovered from the disease or have suffered a mild or symptomless infection may pass out the bacteria in their urine for as long as three months and are thus able to infect other cattle.

Pigs are often carriers of the disease and while showing no sign of sickness may void the infection in their urine for up to a year or longer. Many outbreaks of redwater in calves have been shown to have been associated with infected pigs.

Leptospirae are rapidly destroyed by drying but may survive in mud and water for long periods. Wet, poorly drained calf paddocks contaminated by the urine of pigs or cattle or by drainage from cowsheds or pig sties consequently favour the occurrence and spread of infection.

The habit of sucking one another after feeding, so commonly observed amongst calves, further assists the spread of infection.

SYMPTOMS

Calves.—Calves from three to ten weeks old are often affected and outbreaks are confined to the wetter months of the year. The incidence varies from herd to herd and while on some properties only a few cases may be observed, the majority of the calves may become affected on others. The incubation period is four to ten days.

The symptoms consist of loss of appetite, depression and fever, accompanied by the passage of reddish or reddish-brown urine. The gait is weak and unsteady and there is evidence of anaemia and jaundice, i.e., the membranes of the mouth and eyes are pale and bloodless and show a yellowish discolouration. In acute cases death may occur in three to four days and sometimes within 24 hours of the onset of symptoms.

The mortality rate though usually high is variable—it may be as low as 5 per cent. or it may approach and sometimes exceed 80 per cent. Recovery without treatment is not uncommon but a period of six weeks may elapse before the condition of the animal is fully restored. Some calves remain unthrifty and may have to be destroyed. Mild cases in which the symptoms consist only of dullness and temporary loss of appetite may also occur and are likely to escape notice.

Adult Cattle.—While sporadic cases are not unusual, few outbreaks of leptospirosis have been reported among adult cattle in Western Australia but, where they have occurred, symptoms of fever, haemoglobinuria (redwater) anaemia and jaundice

as in the case of calves have been observed. In addition there is a sharp and sudden fall in milk production and the secretion may be altered in appearance and tinged with blood. In some cases the udder becomes hard and swollen, in others it is slack and pendulous and the animal may go dry but a return to production—though at a reduced level—in about a fortnight is more usual. The mortality rate in adult cattle is low and milder cases with reduced production or symptomless infections appear to be more common. Abortions may occur in some infected herds.

Pigs.—Surveys have shown that pigs are very commonly infected with leptospirae and that they pass out the organisms in great numbers in their urine for prolonged periods and thus provide a reservoir of infection for cattle. With the exception that pregnant sows may give birth to stillborn or weak and sickly piglets which die within a few days of birth, the infection in pigs is usually symptomless.

POST-MORTEM APPEARANCES

In acute fatal cases, evidence of anaemia and icterus or jaundice will be observed. The blood is pale and watery and the fat and other tissues show a yellow discolouration. The liver and spleen are enlarged and the kidneys are darker than usual and may contain small haemorrhages. The bladder contains red urine but is otherwise normal.

PREVENTION

Calves must be protected against infection from areas contaminated by the urine of infected pigs or cattle. The following precautions should be taken—

(1) Do not allow pigs to roam at large on dairy farms. They must at all times be confined within pig-proof yards or sties so as to exclude them from calf paddocks and areas grazed by adult cattle.

(2) Use calf pens and paddocks for calves only. Calves must not be allowed access to areas used by pigs or cattle.

(3) Do not allow drainage from pig sties, cow sheds or cow yards to discharge into or pass through calf paddocks.

(4) See that calf paddocks are dry and well drained. Stagnant pools and muddy areas in which the infection is able to survive must be avoided.

(5) When the disease appears in a herd, isolate all calves subsequently born from the affected group and rear them on clean ground.

(6) Avoid the purchase of pigs or cattle from properties upon which an outbreak of redwater has been known to occur.

It should be recognised that the infection is transmissable to man, and antiseptic precautions including thorough washing of the hands should always be taken when handling affected herds. In man leptospirosis is known as Weil's disease and cases have frequently been reported in dairyfarmers as a sequel to the careless handling of infected pigs and cattle.

TREATMENT

For the treatment of affected calves best results have been reported from the injection of streptomycin in a dosage of 0.5 gram per 100 lb. liveweight for two or three days which not only effects a clinical cure but also clears the urine of leptospirae and thus eliminates "carriers."

Vaccines for the prevention of leptospirosis have been used with success in other countries but none of these products is yet available in Australia.

Fig. 1.—Using a tractor-mounted buckrake to top off a silage pit.

MODERN SILAGE MAKING

By H. G. ELLIOTT, Assistant Superintendent of Dairying.

DURING recent years there have been phenomenal advances in grassland production in many parts of the world, and the conserving of much of the surplus spring growth of pastures and fodder crops in the form of silage is becoming increasingly popular. Silage-making is recognised as a sound farming practice which not only improves the stock-carrying capacity of a property but also increases the production of the individual animals.

More and more dairyfarmers are realising that they must conserve silage to balance the big seasonal variation in pasture growth, and for use during dry periods or when adequate green grazing is not available. To maintain a reasonable level of production there is a constant demand for nutritious feed by livestock through the year.

In Australia it has been estimated that to maintain a dairy cow in good production at least two tons of hay and two to four tons of silage should be conserved each year; for beef cattle about half of this quantity; and for sheep about two to three cwt. of hay and five to seven cwt. of silage. It is considered that these quantities conserved in good years may lead to the accumulation of a reserve which could be utilised in years when full conservation is not practicable.

A few years ago, the making and feeding out of silage entailed much heavy manual labour which was costly in time and money.

Today there are many mechanical aids available which have reduced these costs to an amazing extent.

Silage has many advantages. Many types of vegetation—including weedy crops and pastures—may be safely and economically ensiled, with an assured aftermath of regrowth for late spring or early summer grazing.

Silage-making may be carried out under weather conditions that would prevent or delay haymaking. Neither the labour nor the machinery used for silage-making are likely to be simultaneously needed on other urgent jobs, as grass and cereal silage, which is normally made in the spring, is conserved much earlier than hay.

Any additional machinery or equipment that may be needed is relatively cheap; a minimum of labour is required; storage

methods are simple and cost little or nothing, and finally, the product is fire and vermin proof.

It is recommended that farmers should always make silage in the paddock from where the material is harvested, as it reduces the cost of making and feeding out. Apart from that, it is essential that silage should be fed back on to the paddock from which the material was cut, as a 5 to 6-ton crop would remove about £2. 10s. worth of fertiliser elements in nitrogen, phosphate and potash, without taking into consideration the minor constituents.

When fed out in the summer and autumn months in Australia, silage provides a good substitute for green pasture or green feed, but weight for weight it contains about one-third less feed value than good quality hay owing to its higher moisture content.

The selection and preparation of the paddocks for harvesting is most important. These should be top-dressed early and lightly cultivated to level off. During early August they should be closed up from stock, after light grazing in the winter months, harrowed to spread cow pats and all sticks and stones removed and any obstructions marked so that they can be seen during mowing and harvesting.

Prior to harvest time it is advisable to go over all machinery which will be used to see that it is in good working order and will not cause delays in operations.

TIME OF CUTTING

When considering this most important point it is worth remembering the following points:—

(1) For a good quality product it is necessary to cut the green material as early as possible, and by doing this the maximum regrowth of pasture will take place.
(2) The ideal stage for cutting is just before the bulk of the material to be harvested is commencing to flower.
(3) It is essential to see that there is the maximum leafiness of material for ensiling.
(4) With haymaking the correct time to cut is later when the bulk of the material to be harvested is in flower.

METHOD

Silage is preserved green fodder which is succulent and nutritious. The preservation is generally produced by lactic bacteria from sugars contained in the plant. Therefore conservation depends on the fermentation of sugars in the silage

Fig. 2.—Tractor-mounted buckrake attached to the hydraulic lift system of a light tractor.

Fig. 3.—A front-end "muck-rake" used in feeding-out from a silage pit.

to produce acids which "pickle", or preserve, the fodder from further decomposition.

For best results the green material should be high in sugar content for this fermentation process; if not, it may be necessary to add molasses to assist this action.

Grasses, maize, millet, sorghum, green cereals, all make excellent silage as do mixed swards of clover and grass. Lucerne and pure clover swards which contain high protein do not make the best silage unless molasses is added at the rate of 40 lb. diluted with water for each ton of material made.

When making the silage the cells of the green material ensiled, breathe as long as air is available, and while this breathing continues heat is produced. At temperatures between 70 to 103°F. the lactic bacteria multiply rapidly and, when this acid is at a concentration of approximately 2%, preserve the fodder as silage indefinitely, providing all air is excluded.

Temperature control is most essential for making good silage and the ideal temperature is about 110°F. If the material does not heat up properly, fermentation cannot take place and the silage deteriorates, but if it gets too hot it will char. Overheating can be reduced by rolling to consolidate and exclude the air.

Lush pasture heats slowly, so it is necessary to wilt the material before carting, raking or baling. Ripe and partly dry material can overheat very rapidly.

Very lush unwilted green material can be used to seal off the stack by thorough rolling. This will form a tight seal over the top and herringbone rolling with the tractor is recommended.

Overseas the mechanisation of this form of fodder conservation has made rapid strides in the last six or seven years, and it can be said that this form of conservation is becoming increasingly popular with the farming community and has gained much headway due to the innovations of many mechanical contrivances and the modifications in making and feeding out.

It was said after the war that owing to increasing labour costs and shortage of manpower, silage was a stock food of the past unless a new approach to the problem of storage and handling both in and out was evolved.

The need for reducing construction costs of silos, and the man-hours required to fill and empty them, was felt in all countries and it was not long before such innovations such as the buckrake, horizontal silos, stacks, baling, muckrakes, mechanised knives and self-feeding were introduced and adopted. Most of these new ideas are now being put into practice in Australia.

In the United Kingdom and on the Continent it is a common sight to see silos, silage clamps, stacks and pits, but it is obvious that the long narrow low wedge-shaped stacks and horizontal silos, either uncovered or topped with earth or limestone, with or without a first protective cover, have come to stay.

One of the main challenges today is to find ways and means of reducing the amount of spoilage, which is usually 5% to 10%, with methods other than the overhead silo; to perfect self-feeding methods; to devise mechanism for removal of silage; to convert rapidly large surpluses of grass into silage and to find simple economical methods of storing the material. This challenge has been taken up in the U.K. and U.S.A. and many new methods have been introduced.

Mechanical methods for handling the green material for conserving are divided into three sections:

A. The buckrake.

B. The hay baler.

C. The silorator or mower-chopper combination such as the forage harvester.

The Buckrake

Most farmers in this State are now familiar with the buckrake which is attached to the tractor and used for picking up the green material and carrying it to the storage site—either a pit or a horizontal silo such as a clamp or wedge-shaped stack. It has been estimated in Western Australia that this method of conserving costs between 13s. and 15s. per ton. When filling pits or making wedge-shaped, horizontal silos or clamps, the tractor is used for rolling to give compression, and the top sealing can be done by using very lush green material on top which has been rolled until full consolidation has taken place.

The Hay Baler

Baled green grass for silage making is rapidly gaining in popularity with pickup baler owners, as the modification on the metering wheel, whereby the bales are made half the length and weigh 60 to 70 lbs., has reduced heavy work and labour costs. In England it is stated that it can cost up to £2 per ton to make silage by this method, and that about 33% of this cost is for baling and twine. In Western Australia baler twine would cost about 7s 6d. per ton or 2½d. per bale, but much less if binder twine is used. The time taken to cut and bale in the field naturally depends on the typle of bulk of the crop being handled, but will range from 1¼ to 1½ hours per acre for a 6-ton crop. For a farmer who owns a baler, an average cost of silage making by this method, including labour, tractor depreciation and repairs, would be in the vicinity of 25s. per ton.

At Wagga in New South Wales, making 50 to 60 tons per day, four men with two tractors, haybaler, rake, mower and trailers, worked their costs out at £1 1s. 6d. per ton. This figure was made up as follows: Labour 4s. 3d. per ton, twine 7s. 6d. per ton, tractors 7s. 6d. per ton, and machines at 2s. 3d. per ton.

It must be pointed out, however, that by baling there is a reduction in the amount of consolidation necessary when making, and rolling is generally only necessary in the final stages of building and particularly just before finishing off. Although only limited information is as yet available of the operation in this State, it is claimed elsewhere that rolling should not be carried out until 24 hours have elapsed, as by then the baled material has had time to settle in the stack.

When making baled silage a themometer is considered essential, for once the heat in the bottom layers reaches between 110-115°F. the completion of the building must be done as rapidly as possible in order to make the best quality silage.

Bonding the bales in the pit or clamp is not recommended as it makes the task of removing harder. The twine should be on top and at right angles to the line of rolling.

There are a number of points in favour of baled silage, and these can be enumerated as follows:

(1) In the clamp or pit the baling twine does not rot, consequently the material is easy to remove by the strings.

(2) The bales of silage are easy to carry and handle which is an advantage over handling loose material.

(3) As the bales are reasonably uniform in weight it is easy to work out the amount of silage to put out for the stock at each feeding.

Fig. 4.—Side and end views of one of the popular wedge-shaped silage stacks.

(4) By baling it is easy to calculate the yield from fields and, if counted in, the tonnage made in the pit or clamp.

There are, however, some disadvantages, in that, if loose bales are put in they are hard to remove and, if bales are not stacked well, air pockets are formed which cause moulding and charring of the material in that area. Probably the main disadvantage may be the cost of making silage this way over the buckrake method, but if a farmer has a baler the cost may not be much greater, although more saving would be made in feeding out by bales than with the loose material.

Forage Harvesters

During recent years machinery firms have designed combination mower-chopper-blower machines for handling green material and self-unloading trailers for putting this chopped material into silos, pits, clamps and horizontal silos. One man can do the whole job with this modern machinery, but apart from self-feeding, usually special machinery is required to handle out this type of material, and feeders are required, otherwise wastage can be high. South Australian and Queensland results indicate that the cost of making silage with a forage harvester is in the vicinity of 19s. to 24s. per ton.

ADDITIVES

The use of additives for silage, such as salt, molasses, solrose, sodium bisulphite, etc., is carried out in many places, but it is generally considered that with proprietary lines they are too costly, and in any case if the material ensiled is of high quality, cut and handled at the right time and efficiently, these additives are not needed.

Because sodium meta bi-sulphite costs about 1s. 6d. a lb. and 8-10 lb. have to be used per ton of material, it is considered by many farmers to be too costly. It is a powder which when added and in contact with moisture, releases sulphur dioxide, thereby using up large quantities of oxygen and thus eliminating the heat in the silage. By this method it is stated that the silage retains more green colour, carotene, and the fresh grass odour and flavour.

FEEDING OUT

Apart from reductions in the cost of making silage, the problem of how to remove the chopped or loose material from the stack or pit for feeding out to stock has been given much thought. Various methods of mechanical removal, self-feeding and motorised cutters are in use.

Mechanical removal such as by using the muck loader on the front of the tractor is common, but this has one major disadvantage in that the material is removed from the top of the pit or stack, which tends to expose to the air too great a surface for drying and spoilage. Its advantage, however, is in ease of handling, loading or spreading, and the saving of man labour.

Self-Feeding. It is evident overseas that horizontal silos, wedge-shaped stacks, pits and clamps, together with self-feeding,

have many possibilties for increasing efficiency and economy of labour operations, and the use of this method of feeding out is increasing considerably by using gates, poles or by electric fences. Very little difficulty is experienced in adopting self-feeding, but the following points which have been raised by overseas users of this method are of interest:

(a) Ample feeding space must be provided.
(b) There is a tendency for "boss cows" to monopolise the feeding area to the detriment of timid cows.
(c) Free access by cows to silage with self-feeding may reduce their intake of other feeds such as hay or dry grass.
(d) It is hard to ration silage when self-feeding is adopted.
(e) Self-feeding saves handling costs, and this is important for, without mechanised equipment, silage is generally handled twice in feeding out to the stock.

It may be said that self-feeding by any system has great possibilities from the point of efficiency and economy, as it appears feasible to let the animals balance their own diets if pasture, hay or silage is available, and hand labour can be eliminated entirely without additional expense for mechanical equipment for feeding out.

Fig. 5.—A silage clamp made from old railway sleepers. This clamp was successfully used for baled silage. It is in sections which can be removed separately when feeding-out.

Fig. 6.—Self-feeding from horizontal silos offers possibilities of saving labour. This is a home-made self-feeding gate. Allow one foot of feeding space for every two to three cows.

Motorised cutting aids such as the "Silo-aid" are now available and reduce the labour involved of hand-cutting out. This machine weighs about 40 lbs. and will cut a run 12 feet long and 8 inches deep in one minute. Other types of mechanical aids are now being designed to reduce labour in cutting out silage from above-ground stacks clamps and trench silos.

STACK AND TRENCH METHODS FAVOURED

It can now be said that, after two generations, stack and trench silos have come back into favour. Tower silos were popular because of the high percentage of wastage in stacks and the inconvenience of handling material in and out of underground silos, but with the modern equipment these older forms of stacks, clamps, pits and trenches can now meet present needs for forage preservation.

Horizontal silos are those in which the length or diameter of the finished product is greater than the height. The available machinery for harvesting, placing, compacting and removing of this crop is making the horizontal silo popular.

Horizontal silos may be in the form of excavated trenches; dike silos made on rising ground or hillsides, box or clamp silos where the floor and sides are above ground, as well as the many forms of the free pile or stack silo. These may be of the low, wide, wedge-shaped form, the loaf centre pole type or the bun type.

Some stacks are left unprotected, others are enclosed in a wire and mesh shell with walls of sisal paper or plastic material.

Each type of silo fits the needs of some farmers better than others, but, in general, it will be found that a horizontal stack of suitable size is a good economical method of silage-making.

There are upper and lower limits to the economical sizes of any type of silo, and horizontal silos are often built too small to be satisfactory. The percentage of waste material is necessarily higher in a small stack, but in many cases the low yields of good silage in these stacks resulted from the mistaken belief that crops in any condition, put into a heap, will preserve themselves.

Good silage is only obtained when suitable green material that is not too mature, is ensiled properly with due attention paid to the compacting of the material and effective sealing of the surface layer.

It is anticipated that with the mechanising of silage-making and feeding out, much more of this valuable conserved fodder will be made in the South-West of this State.

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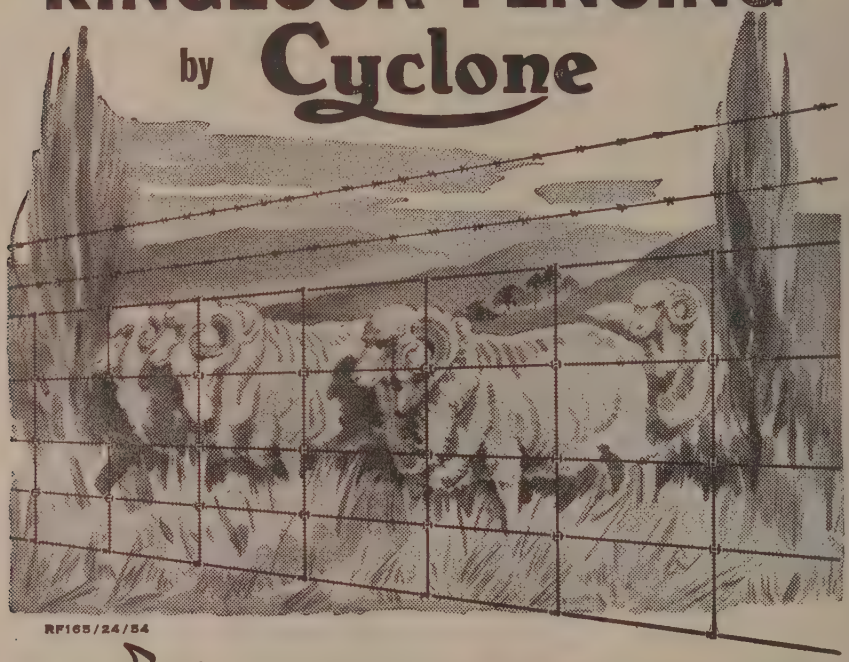
by Cyclone



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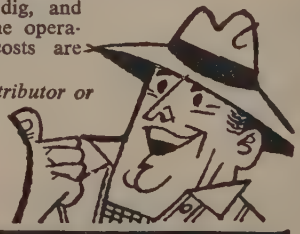

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Fig. 1.—Sheep in a race can be branded cleanly (left). Chasing them round a yard (right) results in smudged misplaced brands.

WOOLBRANDING OF SHEEP

How to Obtain the Best Results

By Officers of the Sheep and Wool Section.

LEGISLATION to enforce the compulsory woolbranding of sheep in Western Australia was introduced at the request of farmers' organisations in 1952. It was felt that the woolbrands would serve as a means of readily establishing ownership of lost or strayed sheep and would act as a deterrent to sheep-stealers.

With the exception of registered stud animals and lambs under six months old, all sheep in the following areas must bear registered woolbrands—

(a) The road districts of Dundas, Esperance, Westonia and Yilgarn.

(b) The South-West Land Division of the State.

(c) Such parts of the Lake Grace, Merredin, Narembeen and Phillips River road districts that are outside the South-West Division.

Woolbranding of sheep outside the areas listed above is not compulsory except when the animals are moved off the run; for instance, if they are travelled, sold or offered for sale.

Observations made at a number of saleyards indicate that many woolbrands are smudged and illegible so that much of the protection they should confer is being lost.

Sheep must be branded to conform with the regulations, and it costs just as much in time, labour and material to apply a smudgy, illegible brand as it does to do the job properly.

In this article we hope to indicate how woolbranding can be carried out so as to give the best results—clear, legible brands that are a definite advantage to the flock-owner.

BRANDING FLUIDS

The first step is to use the correct branding fluids. Under the regulations gazetted on May 25, 1955, it is an offence to use

Fig. 2.—A well-branded sheep (left). The brand on the right is out of position and has smudged badly.

other than **SIROMARK** scourable branding fluids which are prepared according to C.S.I.R.O. formulas and approved by that body. The word **SIROMARK** on the container is an indication that the branding fluid measures up to these requirements.

In past years, serious losses to the wool industry have resulted from the presence, in Australian clips, of wool branded with substances which could not be removed by the normal wool-scouring processes.

C.S.I.R.O. research workers recently evolved a branding fluid which, while long-lasting and weather-resistant, can be completely removed in the scouring process. This is only marketed under the name **SIROMARK.**

It is available in blue, red and green colours and is the only woolbranding fluid which may now be used. The colour which a flockowner may use is decided by the Registrar of Brands when the brand is registered.

No black woolbrands are permitted under the Brands Act regulations.

TYPE OF BRAND

Registered brands consist of two letters and a numeral placed in line and not joined together. The arrangement of the letters and numerals, the position of the brand and its colour are all determined by the Registrar of Brands in allotting the brand to the flockowner.

The branding tool should preferably be made from $\frac{3}{8}$in. round iron with the letters well spaced—at least $\frac{3}{4}$in. apart—to prevent blotching. Letters not less than 3in. high have been shown to give clear distinct brands.

Brands that are bevelled or made from thin wire are less satisfactory than those made from $\frac{3}{8}$in. round iron.

Automatic stencil brands are more economical in the use of fluid, and tests have shown that about 2,000 sheep can be branded with one gallon of fluid as against about 600 sheep when the orthodox branding iron is used.

APPLYING THE BRAND

Sheep can be branded with much greater ease and efficiency if they are held firmly in a narrow race.

The ideal is a race 2ft. 6in. wide situated near the counting-out pens but a drafting-race, if long enough, is fairly satisfactory and is certainly preferable to chasing sheep round a yard.

Apart from branding, a narrow race is always useful on a farm for mouthing, culling and general inspection work.

To make the best use of the branding fluid, the maker's directions should be closely followed.

For branding Merinos, it is usually satisfactory to keep a piece of felt or sheepskin pelt in the branding bucket. If kept well covered with branding fluid this enables the iron to be thoroughly coated with fluid before it is applied.

With the more open-woolled breeds, the iron can be dipped directly into the fluid.

Watch the brands carefully and check any faults as they occur. Pack the sheep well into the race so that they cannot move far; make sure that the branding tool carries plenty of fluid; apply it with a quick, firm pressure and remove cleanly without smudging.

For convenience in branding, start at the top end of the race and work down to the other end. As soon as the sheep in the race are all branded, release them immediately so that they do not smudge one another's brands.

After each day's branding is completed, clean the branding tools thoroughly, pour any surplus fluid back into the container and replace the lid firmly.

SUMMARY

1.—Woolbranding is compulsory, and aids in identifying sheep.

2.—It is a simple operation but slipshod methods result in smudged brands which are useless.

3.—**SIROMARK** is the only branding fluid that may be used. Black woolbrands are illegal.

4.—Use a branding tool made from ⅜in. round iron with letters at least 3in. high or alternatively use an automatic stencil.

5.—Sheep should be branded in a race, preferably 2ft. 6in. wide.

6.—Apply the brand with a clean, firm pressure.

7.—Open-woolled breeds need more fluid than close-woolled animals.

8.—Clean up tools and pour off surplus fluid at the conclusion of each day's branding.

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			lb. per Acre Extra Seed	lb. per Acre of Nitrogen Fixed	lb. Weight	Value in Shillings
White Clover	1½ lb.	10d.	1/10th lb.	1/2 lb. nitrogen	102 lb.	172/-
Red Clover	4 lb.	1/2d.	1/5th lb.	2/3rd lb. „	114 lb.	190/-
Lucerne	15 lb.	4/4d.	1/2 lb.	2½ lb. „	194 lb	323/-
Field Peas	4 lb	1/2d.	1/4 lb.	2/3rd lb. „	50 lb	83/-
Vetch	60 lb.	8/9d.	8 lb	5 lb. „	80 lb.	133/-
Sub. Clover	60 lb.	8/9d.	11 lb.	5 lb „	50 lb	83/-
Lupins	60 lb.	8/9d.	10 lb	5 lb „	151 lb.	251/-

Value of nitrogen fixed (last column) based on nitrogen as a commercial fertilizer, would be much higher if based on increases in yields of following crops, due to increased nitrogen content in soil

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AUSTRALIAN TRACTOR TESTS

REPORT ON TEST NO. 26
(Farmers' Edition)

McCORMICK INTERNATIONAL SUPER AWD—6 (DIESEL)

(Tested for the International Harvester Co. of Australia, Geelong.)

THIS Report is taken from the full Technical Report No. 26 of this test; test results are shown here in briefer form: fuller explanations are added. Values quoted here may be rounded out to two instead of three significant figures; to this extent the values quoted may differ slightly but not significantly from those shown in the Technical Report. Graphs of belt test performance, shown in the Technical Report, are not shown here. The Technical Report is not available in large numbers, but may be seen at the offices of the State Departments of Agriculture, the Bureau of Sugar Experiment Stations (Queensland), and the Commonwealth Department of Primary Industry.

1. THE TESTS

(1) After twelve hours of running-in, two types of tests were carried out, in order to measure *the performance of the engine,* as measured by the power in the belt driven by the belt pulley, and *the performance of the tractor as a whole,* as measured by drawbar pull, tractor speed, wheel slip, and drawbar horsepower (d.b.h.p.), with the tractor running on a bitumen test track.

The main results of these tests are given in Sections 2, 3, and 4. Other measurements and observations were made of various features of the tractor; these are given in Section 5.

(2) Fuel Mixture Settings.—The engine of this tractor has only one fuel-mixture setting, at which all the tests were carried out.

(3) Governor Control.—The engine was under the control of the governor set to give maximum power and full throttle at rated engine speed.

(4) Fuel.—Distillate, Diesel Index 53, Specific Gravity 0.84; weight per Imperial gallon 8.41 lb.

(5) Specification.—Engine No. AD264 2636. For a brief specification of this tractor see Section 6 at the end of this report.

The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne ; under this agreement, the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is : C/o Department of Primary Industry, 301 Flinders-lane, Melbourne.

2. SUMMARY OF POWER OUTPUT

Table A.

	At the Belt.	At the Drawbar.
Rated engine speed, r.p.m.	1,450	1,450
Corrected maximum power(*a*)	47·6	42·9
Rated power (*b*)	40·5 (*b*1)	32·2 (*b*2)

(*a*) Corrected maximum h.p. is calculated by a suitable formula from observed maximum h.p. corrected to 60° F. and 29·92″ (sea level) barometric pressure. No correction is applied to diesel engines because there is no suitable formula; the values shown above are therefore the observed maximum powers.

(*b*) Engines are not expected to run indefinitely at full or maximum power output. But they can be expected to run continuously for some hours at *rated* output, which is less than maximum, defined as follows:—

(*b*1) Rated b.h.p. is defined as 85 per cent. of corrected maximum b.h.p.;

(*b*2) Rated d.b.h.p is defined as 75 per cent. of corrected maximum d.b.h.p.

3. BELT TESTS

Table B.—Belt Test Results

If there is only one fuel setting, no mention will be made of mixture settings in this table.

	B.H.P.	Engine Speed.	Fuel. Gall./hr. (*c*).	Fuel. lb./b.h.p. hr. (*d*)
1. Rated engine speed, 1,450 r.p.m.				
2. Fast idling speed about 1,580 r.p.m.				
3. Observed maximum b.h.p. at rated speed	47·6	1,449	2·62	0·46
4. Corrected maximum b.h.p. rated speed (*a*)	47·6	No correction made for diesel engines.		
5. Calculated rated load (*b*1)	40·5			
6. Test at approximately rated load	40·6	1,484	2·25	0·47
7. Average loading under governor (*e*)	25	1,510	1·7	0·55
8. Equivalent engine torque at full throttle	173 ft. lb. at maximum power and rated speed			
	192 ft. lb. (maximum) at 1,050 r.p.m.			
9. Repeat of (3) above after 55 hours	No significant change			

(*c*) Fuel consumption in gallons/hour may be a simple unit, but it has no meaning unless we also quote the corresponding h.p. output.

(*d*) This is the "specific fuel consumption," the weight of fuel consumed per unit of energy developed by the engine; the unit of energy here is the h.p.-hour, similar to the electrical "unit," the kilowatt-hour. When this figure is least the engine is giving its best economy or efficiency. It is easy to change from column (*c*) to column (*d*) in Table B, e.g., as follows:—

2·62 galls./hr. while developing 47·6 h.p. means 2·62 ÷ 47·6 galls./b.h.p./hr. = 0·055 gall./b.h.p./hr.

0·055 gall./b.h.p./hr. x 8·41 lb./gallon for this fuel = 0·46 lb./b.h.p./hr., as shown in column (*d*).

(*e*) Line 7, Table B., represents the average performance one might expect from the engine while driving a variety of belt loads, from light to heavy. In terms of average fuel consumption, it means about 1¾ gallons an hour.

The belt tests show the power (belt horsepower, b.h.p.) that the tractor may be expected to deliver when driving a machine by the belt.

4. DRAWBAR TESTS

(1) The following Tables C, D, and E, show the drawbar performance of the tractor, on the bitumen test track, wearing rear tyres 14 x 30, carrying maximum weight (2,350 lb. front 6,090 lb. rear; total 8,440 lb.), working in the gears named in the tables. Height of drawbar 16 inches.

Drawbar tests, using standard and minimum weights of tractor, were carried out, but are not reported here.

If there is only one fuel setting, no mention will be made of mixture settings in these tables.

Table C.—Maximum Power, Rated (3rd) Gear

	DBHP (*f*).	Pull lb.	Speed m.p.h.	Wheel Slip % (*g*).
1. Rated engine speed, 1,450 r.p.m.				
2. Observed maximum d.b.h.p. at rated engine speed	42·9	3,760	4·28	7
3. Corrected maximum d.b.h.p. at rated engine speed (*a*)	42·9	No correction made for diesel engines		
4. Calculated rated load (*b*2)	32·2			

(*f*) D.B.H.P. is the product of pull (lb.) and speed (m.p.h.) divided by 375.

(*g*) Wheel slip can be measured by noting that, in travelling a given distance, the back wheels make more turns when working under load than when running with no load on the drawbar. The difference in these revolution counts divided by the former count gives the slip as a ratio, which can be written as a percentage (quoted in these tables to the nearest whole number).

Table D.—Pull at Maximum d.b.h.p.

All gears, rated engine speed. See note (*h*).

Gear.	D.B.H.P.	Pull lb.	Speed m.p.h.	Wheel Slip %
1	23	5,900	1·4	17
2	42	4,960	3·2	10
3	43	3,760	4·3	7
4	43	3,060	5·3	6
5	Road speed not tested			

(*h*) These are not the maximum pulls available in the gears (i.e., not the maximum sustained pulls), but the pulls at maximum d.b. power, i.e., at full-throttle at rated engine speed.

Table E.—Fuel Consumption, Various Loads, Rated (3rd) Gear

Pull. lb.	Speed. m.p.h.	DBHP.	Per cent of Maximum d.b.p.h.	Slip. %	Fuel. Gall./ hr.	Fuel. lb./ d.b.h.p. hr.
1,600	4·73	20	47	3	1·5	0·61
2,100	4·64	26	61	4	1·7	0·55
2,700†	4·53	33†	76†	5	2·0	0·52
3,400	4·40	40	93	7	2·4	0·50

† Approximately the rated drawbar load.

(2) Interpretation of Drawbar Tests.

(i) Drawbar tests are carried out on a hard prepared surface. Most field conditions present higher resistance to the tractor's motion, so that, in the field, the maximum drawbar pulls available in any gear will usually be less than those shown in the tables.

(ii) Wheel slip may also be greater in the field; to that extent tractor speeds in miles per hour in the field will be less than those shown in the tables.

(iii) Because of (i) and (ii) above, the drawbar horsepowers available in any gear in the field will usually be less than those shown in the tables.

5. OTHER OBSERVATIONS

(1) Duration of Test.—55 hours, including running-in.

(2) Repairs and Adjustments.—None.

(3) Engine.—

Fuel settings—one only.

Heat controls—radiator, thermostat on water by-pass.

Radiator water used—negligible.

Lubricating oil—type used, S.A.E. 20.

Weight to engine, 14.9 lb.;

Weight from engine after tests, 12.4 lb.

(4) Tractor Weights (lb.)

——	Front.	Rear.	Total.
Minimum weight, unballasted	2,170	4,335	6,505
Added weights	80	280	360
*Weight, as usually supplied	2,250	4,615	6,860
Water Ballast	....	920	920
Standard weight	2,250	5,535	7,780
Added weight	....	560	560
Water ballast	100	....	100
†Maximum weight, heaviest recommended	2,350	6,090	8,440

* This weight, less driver and fuel, was used in finding centre of gravity.

† Weight of tractor in drawbar tests quoted in this report.

(5) Wheels and Tyres.

Tyres.	Front.	Rear.
Type	Rib	Open centre bar tread
Size	7·50 x 16 x 6 ply	14 x 30 x 6 ply
Pressure	36 psi.	12 psi.

(6) Steering.—With track widths, front 47", rear 55". Wheel base 76½"

Turning circles: Without brakes, 26′ L.H., 25′ R.H.; with brakes, 23′ L.H., 22′ R.H.

Comment: Easy to steer under load, sensitive to steering wheel.

(7) Centre of Gravity, with tractor in standard weight less water ballast and driver.—4½" above, 2′ 2" forward of rear axle.

(8) Driver's Accommodation.—*Access to seat,* from back of tractor. *Foot-room and support,* adequate. *Comfort,* seat flexibly sprung, adjustable fore and aft. *Accessibility to controls,* clutch and brake pedals 23½" apart, centre to centre, pedal treads approximately 4" below loaded seat. Parking brake latch under right heel awkward to apply. Handling of gear lever in low gear conflicts with left leg.

(9) Instruments.—All clearly visible, band markings adequate. Indications were consistent throughout tests.

(10) Inspection of Engine and Transmission after Test.—After testing, the tractor was partly dismantled and inspected and found to be in a satisfactory condition.

(11) Instruction Books.—Instructions for starting, running, and maintenance were satisfactory.

G. H. VASEY,
Officer in Charge Tractor Testing.
I. T. NAYLOR.
Tractor Testing Officer.
16th August, 1955. University of Melbourne.

6. BRIEF SPECIFICATIONS: International Super AWD—6

(Based on Information Supplied by Manufacturers)

(1) Engine—No. AD264 2636. (I.H.C., Australia.)

4-stroke; 4 cylinders, vertical; crankshaft along tractor.

Bore, 4"; stroke, 5¼"; compression ratio, 16.7 : 1.

Rated speeds: Belt work, 1,450 r.p.m.; drawbar work, 1,450 r.p.m.

Fuel type: Distillate.

Fuel system: C.A.V. pump and injectors Filter, water traps and replaceable element. Tank capacity, 17½ gallons.

Air Cleaner: Oil bath.

Governor: C.A.V. centifugal.

Electrical system: 12-volt battery and generator.

Starting: Electric, Bosch glowplugs.

Cooling: Pressurised water, fan, pump and thermostat, no radiator shutters.

Exhaust: Straight-through type; I.H.C. spark arrester usually fitted.

Lubrication: Oil pump and by-pass filter.

(2) Chassis—

4-wheel; pneumatic tyres.

Wheel base 76½".

Track width: Front 47"; rear 55", adjustable.

Tyre sizes: Front 7.50 x 16; rear 14 x 30.

Steering Gear: Worm and gear.

Weight: Maximum weight, 8,440 lb. (see "Other Observations," section 5).

(3) Belt Pulley—

Optional; right side, clockwise rotation.

Diameter 11"; face width 7½".

Speed (at rated engine speed), 899 r.p.m.

Belt speed (at rated engine speed), 2,590 ft./min., not in accordance with overseas standards (namely, 3,100 ± 100 f.p.m.). Using 13" diameter pulley should give belt speed approximately 3,060 f.p.m.

(4) Power Take-off—

Optional; guarded; location, centre rear.

Speed: 537 r.p.m., in accordance with overseas standards (namely, 536 ± 10 r.p.m.).

Dimensions: 6 spline, 1⅜" diameter.

(5) Drawbar—Swinging.—

Height, as tested 16", adjustable 8½" to 18".

(6) Transmission—Conventional gears.

Clutch: Single dry plate; 12" dia; pedal control.

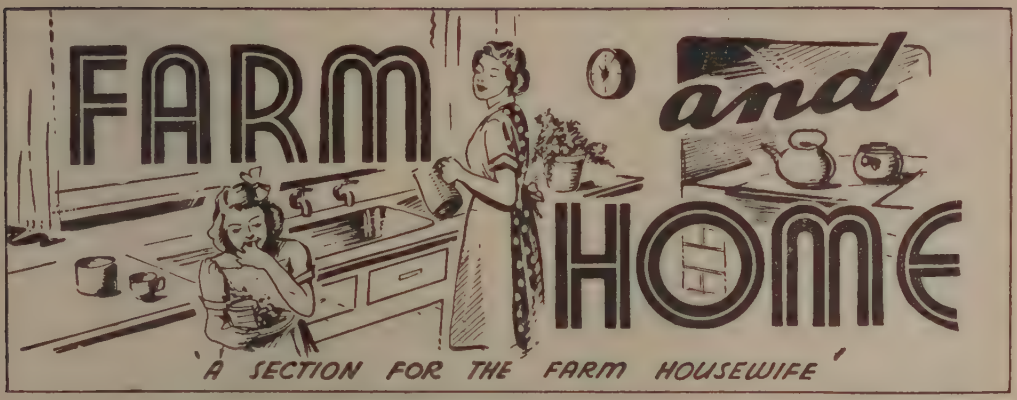
Gear ratios and road speeds (assuming no wheel slip) on 14 x 30 tyres, at rated engine speed, as advertised:—

Gear.	Forward.					Reverse.
	1	2	3	4	5	
Ratio	139·6	64·8	49·9	41·2	14·8	106·5
Speed, m.p.h.	1·7	3·7	4·8	5·6	16·1	2·3

(7) Hydraulics—Optional, not fitted.

(8) Three-Point Linkage.—Optional, not fitted.

(9) Spark Arrester.—Standard but not fitted. Muffler fitted for test.



DRIED FRUIT COOKERY

By BRENDA CLEEVE

THE housewife will readily appreciate the value of dried fruits in helping her to provide variety at mealtimes, especially in districts where fresh fruits are not readily available. Apart from this aspect, dried fruits, with their concentration of flavour and sugar, make welcome and fairly economical additions to the bill of fare. Many of the health-giving properties of fresh fruits are retained in the dehydrated products—iron and laxative elements being two of the more important.

The larger types of fruit such as apricots, pears, peaches and apples are mainly used as substitutes for fresh fruits, but the smaller varieties (raisins, dates, currants, sultanas) are more frequently used to add flavour and variety to cooked dishes. Prunes fall into a class of their own between these two groups and are usually marketed in a semi-dried state.

Most people make the mistake of adding too much sugar when cooking with dried fruits and so destroy the distinctive flavour. When fruits are dried, only the water is removed and the natural sugars present become concentrated. Some of the water is replaced by cooking or soaking but the sugar content is still higher than that of fresh fruit. This applies particularly to prunes which require very little extra sugar.

To cook dried fruits, soak them in cold water for 24 hours. Stew gently for 10 to 15 minutes, or until tender, in the soaking water. Where most of this has been absorbed by the fruit, a little more may need to be added. Dried fruits may be cooked without the previous soaking provided that plenty of water is used and they are cooked 30 to 45 minutes with the lid on the pan.

Just before the fruit is cooked add the sugar allowing ¼ cup to each pound of dried fruit. A few slices of lemon added while fruit is stewing improves the flavour.

If prunes are very fresh and fairly soft they can be prepared simply by pouring boiling water over them and allowing them to stand overnight. The same result can be obtained by covering the prunes with cold water, just bringing them to the boil and leaving them to cool in the water. Sugar can be added to taste if required.

Badly-cooked or badly-prepared fruits are most unappetising. Any grittiness in the fruits is due to insufficient washing and cleaning. Where the fruit is not required to be used in a dry state, or if it can be left for two or three days to dry out again, it should be thoroughly washed before using. Place the fruit in a strainer or collander and hold it under a running tap, at the same time moving the fruit around to free dirt and loose stems; or stand the strainer in a basin of water and move the fruit around so that the dirt falls to the bottom of the basin. Dry the fruit by rubbing it in a clean cloth and spread to dry on a plate in a warm place.

Tough fruit is due to insufficient cooking while a mushy pulp is the result of over-cooking.

DRIED FRUIT RECIPES

Try some of these puddings on the family.

Bread Pudding

2 cups of milk.
4 cups of bread crumbs.
2 tablespoons butter or margarine.
4 tablespoons sugar.
2 eggs.
½ cup of chopped raisins.
pinch salt.

Heat the milk to boiling point and pour this over the breadcrumbs. Allow to cool. Beat the eggs, add the sugar, raisins, salt and melted fat. Add this mixture to the soaked breadcrumbs and stir together. Pour into a greased pie dish. Bake in a moderate oven for 40-50 minutes or until the mixture will leave a knife cleanly.

Plum Duff

1 cup brown sugar.
3 tablespoons butter, margarine or good fat.
2 cups cooked prunes.
2 eggs.
1 cup flour.
1 teaspoon baking soda.
pinch salt.

Beat the eggs, add the melted fat and the chopped and stoned prunes. Sift the flour, salt and baking soda and stir this into the egg mixture. Pour into a greased basin and steam for one hour.

Raisin Pie

Pastry—sufficient short pastry to line and cover an 8in. pie or tart plate.

Filling—

1½ cups of chopped raisins.
1½ cups of boiling water.
2 tablespoons sugar.
2 tablespoons flour.
½ cup chopped nuts.
Grated rind and juice of 1 lemon.

Line the plate with the short pastry. Cook the raisins in the water until they are soft. Mix the flour and sugar together and stir this mixture into the cooked raisins. Stir over a low heat until the mixture thickens and boils. Remove from the heat and stir in the nuts and lemon rind and juice.

Pour this hot mixture into the lined plate and cover with another layer of pastry.

Bake in a hot oven 30 to 40 minutes or until the pastry is cooked and a golden brown.

Upside-down Pudding

Topping—

2 tablespoons brown sugar.
1 dessertspoon butter.
1 dessertspoon lemon juice.

Batter—

½ cup sugar.
2 tablespoons shortening.
1 egg.
¼ cup milk.
1 cup S.R. flour.
Pinch salt.
A few drops of flavouring.

Melt the butter in the baking dish. Add the brown sugar and lemon juice and mix together. On top of this mixture place a layer of cooked fruit—prunes, apricots, peaches. To make the batter beat the fat and sugar together and then add the egg. Add the sifted flour alternately with the milk. Pour this mixture over the layer of fruit in the baking dish. Bake in a moderate oven ¾ to 1 hour. Turn onto the serving plate and serve with the layer of fruit uppermost.

Rhubarb-Raisin Pie.

8 oz. good short pastry.
1 tablespoon butter.
3 tablespoons sugar.
1 egg.
Grated rind and juice of an orange.
1½ cups raw, chopped rhubarb.
1 cup chopped raisins.

Line a tart plate with the pastry. Beat the fat and sugar together. Add the egg and lemon rind and juice. Stir in the rhubarb and raisins. Pour this mixture into the lined plate. Cover with a pastry top. Bake in a hot oven until the pastry is risen and set and then in a moderate oven until the filling is cooked (30 to 40 minutes).

Steamed Devon Pudding

1 good tablespoon butter.
3 level tablespoons honey.
1 egg.
3 tablespoons milk.
6 oz. self raising flour.
Flavouring essence
3 tablespoons chopped sultanas.
1 tablespoon chopped nuts.

Beat the butter and honey together until soft. Add the beaten egg and beat again. Add the milk, flavouring and chopped sultanas and nuts. Lastly stir in the sifted flour. Pour the mixture into a greased basin and steam for 1½ hours.

Fruit Betty

2 cups dried fruits.
½ cup sugar.
1 cup fresh bread crumbs.
2 tablespoons butter.
A level teaspoon cinnamon.
Rind and juice of a lemon.

Partly cook the dried fruit and drain thoroughly. Mix the breadcrumbs, sugar, cinnamon and lemon rind. Place the fruit and breadcrumb mixture in alternate layers with small pieces of butter dotted between them in a greased pie dish, finishing with a layer of breadcrumbs. Add the lemon juice made up to half a cup with fruit juice or water. Cover the pie-dish with greased paper. Bake in a moderate oven 30 to 40 minutes. Remove the paper and replace the pudding in the oven until the top is brown. Serve hot or cold with cream or custard.

Vienna Custard

1 cup milk.
1 egg.
2 tablespoons sugar.
1½ cups diced bread.
3 tablespoons sultanas.
2 tablespoons chopped peel or the rind of a lemon.
2 tablespoons cream.
2 tablespoons sherry.

Beat the eggs and sugar, add the milk, cream, sherry, and fruit. Pour this mixture over the diced bread and allow to stand for an hour. Pour into a greased basin and steam for 1 hour. Serve with a sauce flavoured with wine or brandy.

SAVOURIES

Delicious savouries can be prepared quickly using prunes as the main ingredient.

Choose soft, fleshy prunes and remove the stones. Fill the cavities thus made with cream cheese, peanut butter or a savoury egg mixture. If these are being prepared in any quantity it is much easier to fill them with a forcing bag and nozzle as used for cake icing. Prunes can also be rolled in bacon and grilled or baked slowly with the bacon is just cooked. Use tooth picks to hold the bacon in place or thread the rolls on a skewer.

JAMS

Dried Apricot Jam

2 lb. dried apricots.
8 pints water.
5 lb. sugar.
¾ cup blanched almonds.

Wash the apricots and soak for 24 hours. Cook gently until soft. Add the almonds and the sugar and cook until the jam will "jell." Bottle while hot and cover.

Apricot and Passionfruit Jam

2 lb. dried apricots.
8 pints water.
5 lb. sugar.
1 cup passionfruit pulp.

Follow the directions for the above recipe, adding the passionfruit pulp just before the sugar.

Fig and Rhubarb Jam

4 lb. rhubarb.
1 lb. sugar.
1½ lb. dried figs.

Cut the rhubarb into pieces and place in a basin sprinkled with about half the sugar. Allow to stand overnight. Strain off the liquid and add the rest of the sugar. Bring to the boil. Add the chopped rhubarb and boil for half an hour. Add the cut up figs. Boil further until the jam will "jell".

Fruit Fingers

Biscuit mixture—

8 oz. flour.
4 oz. butter or margerine.
2 oz. sugar.
1 egg yolk.
pinch salt.
flavouring essence.

Filling—

4 oz. dates.
¼ cup water.
¼ cup chopped nuts.
1 tablespoon lemon juice.

Cream the butter and the sugar. Add the egg yolk and flavouring essence. Add the sifted flour and salt to make a stiff mixture. Use half of this mixture to line a baking tin.

Chop the dates and place in a saucepan with the other ingredients. Cook over a slow heat until the dates are soft. Cool and spread over biscuit lining.

Roll out the other half of the paste to cover the date filling. Bake in a moderate oven 10 to 15 minutes. Cut into fingers immediately.

Rice Cookies

2 oz. butter or margerine.
1 oz. sugar.
1 egg.
5 oz. ground rice.
3 oz. plain flour.
1 teaspoon baking powder.
3 oz. sultanas or other dried fruits.
1 oz. chopped lemon peel.

Sift the rice, flour and baking powder. Rub in the fat until the mixture ressembles breadcrumbs. Add the fruit, peel and sugar. Add the beaten egg to make a stiff mixture. Use a little milk or water if the egg liquid is insufficient. Toss on a floured board. Roll out to ¾in. thickness. Cut into bun shape. Brush with milk and place strip of lemon peel across each one. Bake in a hot oven 10 to 15 minutes.

Wheatmeal Fruit Bread

4 cups fine wheatmeal.
1 teaspoon salt.
4 teaspoons baking powder.
2 tablespoons good dripping.
½ cup golden syrup.
1½ cups chopped dried fruits.
water or milk to mix.

Mix the wheatmeal, salt and baking powder. Rub the fat into the flour. Soften the golden syrup with two tablespoons of hot water. Add enough milk or cold water to make up one cup. Make a well in the middle of the flour and pour in this liquid. Commence stirring in the flour adding more liquid as required to make a stiff batter. Pour the mixture into a greased tin. Bake in a moderate oven for one and a half hours.

Currant Rice Fritters

½ cup milk.
2 eggs.
2 tablespoons currants—other dried fruits.
1 tablespoon flour.
2 tablespoons cooked rice.
1 dessertspoon sugar.

Sift flour into a basin. Add one egg and then the other and beat together. Add the sugar, and beat for 10 minutes. Stir in the fruit and the rice. Drop in dessertspoon heaps into hot fat (deep) and cook gently until a golden brown. Drain and roll in a mixture of castor sugar and nutmeg or cinnamon.

Fruit Lace

Scone dough—

2 cups selfraising flour.
2 teaspoons fat.
1 cup milk.
1 dessertspoon sugar.

Filling—

1 cup dried fruits—chopped finely or minced.
1 apple chopped or grated.
1 tablespoon marmalade.
2 tablespoons brown sugar.
Grated rind of lemon.
1 tablespoon lemon juice.

Cook all the ingredients for the filling together over a gentle heat for two or three minutes. Allow to cool.

To make the scone dough sift the flour into a basin with a pinch of salt. Rub in the fat. Add the sugar and then the milk to make a soft mixture.

Roll the scone dough to a rectangle about ¼in. thick. Lift onto a greased tray. Spread the filling mixture down the centre of the oblong. On either side of the filling make 3in. cuts about 2in. apart through the dough, making the same number of cuts on each side. Take one strip from each side and cross them over the filling into a mock plait, pulling the strips down and keeping the ends inside. Continue lacing the strips, tucking the last two under. Bake in a hot oven 15 to 20 minutes. When cold, ice with lemon flavoured icing.

COLD WATER STARCHING

By BRENDA CLEEVE

WITH the current vogue for bouffant skirts, cold water starching has once more returned to the laundry routine. For really successful stiffening of full-skirted petticoats, cold water starch, or "raw starch," as it is sometimes called is required. This gives a much stiffer result and one which lasts longer than that obtained with boiled starch. When garments are stiffened in raw starch the heat of the iron actually cooks the starch into the material and it is this which gives the increased stiffness. Even after the garment is washed, quite a lot of stiffening is left so that it is not necessary to re-stiffen in the raw starch each time.

This starch is also used to stiffen beach hats and the cuffs, collars and fronts of evening shirts.

To make Cold Water Starch mix together:

3 tablespoons of starch and

1 pint of cold water.

Rub a cake of washing soap around the bowl until a light lather is obtained.

For successful stiffening, the garment must be completely dry and with any previous boiled starch rubbed out. Mix the starch around just before placing the garment in it. Make sure the fabric is thoroughly moistened with the starch. Rub the garment between the hands so that the starch is forced into the threads. Squeeze out any surplus moisture and, if the garment is a large one such as a petticoat, hang it up until some of the excess moisture has evaporated.

Raw-starched garments s h o u l d be ironed while they are still fairly wet. Before ironing, rub the garment again to rub in the starch and wipe it over with a slightly damp cloth to remove any surface starch. If this starch is left on it will stick to the iron or leave white patches on the surface of the material.

Where possible iron one layer of the fabric at a time. On beach hats, cuffs, collars or shirt fronts where this is not possible iron very lightly on the wrong side and then on the right side. Stretch the garment into position before attempting to iron, as once the starch has been set into position the placement of the threads can only be altered by washing the garment and starting all over again.

Use a hot iron and work slowly so that the material is thoroughly dry before you move onto the next piece. If this precaution is neglected you will be disappointed with the results. If the material dries out while you are ironing, brush it over with a damp cloth to keep it moist.

After the starching has been completed there is no need to discard the starch, as cold water starching is quite extravagant on this ingredient. It can be used up by adding boiling water to make boiled starch for ordinary use. Alternatively, allow the starch to settle, pour off the water and dry the starch paste which remains. It can then be powdered up and used again.

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PATERSON'S CURSE

(*Echium plantagineum* L.)

Echium plantagineum and the related *E. italicum* are known by a variety of common names including Paterson's Curse, Salvation Jane, Blue Weed and Lady Campbell Weed. Opinions differ as to the importance of Paterson's Curse as a weed. Undoubtedly it is of greatest consequence in the higher rainfall areas, but even under short season conditions, should be regarded as an undesirable plant.

WEEDS of Western Australia

By **G.R.W. MEADLY** M. Sc.
Officer in Charge, Weeds and Seeds Branch

PATERSON'S CURSE

(Echium plantagineum L. and E. italicum L.)

PATERSON'S curse is the name applied to two closely related species, Echium plantagineum and E. italicum. Although the two species have certain botanical differences, from a practical point of view they can be grouped under a single vernacular name, a procedure which will be adopted for the remainder of this article.

Paterson's curse is native to the Mediterranean region and Western Europe where it is sometimes cultivated in gardens. The first record of this plant in Australia dates back to about 1895, when it was introduced by a Mr. Paterson as a garden plant to a place near Albury. The spread was gradual until it encroached on a stock route. A rapid movement was then recorded, especially along stock routes and on reserves, until now it is widely distributed in the Eastern States, being particularly conspicuous in South Australia. In the spring, the scenic beauty of Mount Lofty Ranges near Adelaide is enhanced by the masses of violet flowers.

Its early history in this State is associated with the construction of the Great Southern Railway. Lady Campbell, wife of Sir Thomas Campbell, who was residing at the time not far from Broomehill, introduced the plant as a garden subject. It is still known in many parts of the Great Southern as Lady Campbell weed.

It has since spread or been introduced independently to a number of widely separated localities in the agricultural areas including Northampton, Mingenew, Perenjori, Toodyay, Northam, Donnybrook, Bridgetown and various places along the Great Southern Railway. It is also plentiful in the vicinity of Perth, including the Darling Range. Paterson's curse grows freely along roadsides and other places not subject to cultivation or grazing.

DESCRIPTION

The names Paterson's curse and Lady Campbell weed have already been mentioned and their origin indicated. In Europe the plant is known as viper's bugloss, an allusion to the bugle shaped flowers. In South Australia the name Salvation Jane is widely used, as in the lower rainfall areas of that State the plant is considered to supply useful forage when other grazing is scarce. It is also referred to as blue weed, a vernacular name applied to many different plants.

Echium plantagineum is an annual, biennial or rarely perennial herb, first developing a basal rosette of large oval, lance-shaped stalked leaves. Subsequently a stem arises from the rosette and its branches bear heart-shaped leaves without stalks and long, curved racemes of voilet flowers. The calyx is divided into five sharp lobes about one third the length of the tubular, bell shaped corolla. The fruit consists of four angular, wrinkled nutlets which fall from the base of the calyx when mature. Flowering usually occurs from September to November.

E. italicum differs in having a longer inflorescence and somewhat smaller flowers.

PATERSONS CURSE (*Echium plantagineum* L.)

A—Plant, showing habit of growth; B—Leaf and inflorescence; C—Details of Flower; D—Fruit, showing nutlets.

SIGNIFICANCE

The significance of Paterson's curse depends to no small extent on the conditions under which it is growing. In the South-West, with a long growing season it is a very undesirable weed. In the Boyanup-Donnybrook area in particular it has proved very persistent, and eradication from rich moist soils has presented many difficulties. Under such favourable conditions the strong development of basal leaves forms a large rosette which crowds the pasture species. The problem in these districts is magnified by the fact that the greater proportion of animals are cattle which are not nearly as effective as sheep for checking the growth of Paterson's curse by grazing.

Although of lesser importance as a weed in districts having a lower rainfall, despite the common name of Salvation Jane used in South Australia, it is not suggested that Paterson's curse should be encouraged under any conditions. No farmer should be satisfied to allow the plant to become established on his property. Besides interfering with pastures, the presence of the weed may necessitate additional preseeding cultivations in order to prevent excessive competition for cereal crops.

Paterson's curse belongs to the Borage family some members of which, including the common heliotrope (*Heliotropium europaeum*) have been the cause of stock losses. In one or two cases Paterson's curse has been suspected but, as already mentioned, it is grazed extensively by stock in many localities without harmful results.

It has been declared a secondary noxious weed for a number of road districts.

CONTROL

The most practical control measures depend on the extent of the weed and the conditions under which it is growing. When only a few plants occur they should be hoed or hand-pulled before flowering and the area kept under observation for subsequent germination. Where the area is too extensive for individual attention consideration must be given to pasture improvement, grazing or mowing, cultivation or the use of chemicals.

By pasture management it is possible to stimulate the pasture species, thus providing greater competition for the weed and making it relatively less important. In order to cause any significant reduction, grazing must be sufficiently severe and repeated often enough to prevent seed formation or reduce it to a low level. Best results are obtained in the case of small paddocks and sheep, especially rams, are the most effective grazing animals. If grazed on plants bearing seeds, however, these will be distributed by the animals. Mowing at the early flowering stage will also reduce seed formation. The time of mowing is important as, if carried out too early, regrowth may produce flowers which set seed while if too late, mature seeds may be present in the cut material.

Ploughing is effective, particularly in the drier areas where the plant is essentially an annual. Under moist conditions where it is a biennial or possibly a perennial, control by this method may involve several workings in one season. To be really effective these operations must be repeated over a period of several years, not only to destroy the plants present at the commencement but to cope with subsequent seedlings arising from dormant seeds.

Some trials with chemicals conducted in the York district showed that, under lighter rainfall conditions, effective results could be obtained by the application of several different preparations. A 5 per cent. solution of Atlacide (sodium chlorate) or arsenic pentoxide applied at the rate of 100 gallons per acre controlled the weed, particularly if applied at the early flowering stage when little, if any, recovery occurred. Further seedlings appeared and reached maturity following treatment when the main emergence was at an early growth stage. These treatments, although practicable for small areas, are too costly for large infestations and arsenic pentoxide has the additional disadvantage of being toxic to stock.

For chemical control, chlorates and arsenicals have been largely superseded by the 2,4-D or hormone-like weedkillers which are less costly and non-poisonous. Under pasture conditions good results with Paterson's curse have been obtained by the application of one to two pounds

of acid equivalent per acre, the ester formulations being favoured. The lower rate is sufficient when the plants are small and not very dense but as they become larger their resistance increases and for large plants 2 lb. acid equivalent per acre is often necessary. This rate of application will damage clovers but seldom causes any serious effect to grasses. When clovers are involved, the amine is sometimes used in preference to the ester as it is somewhat less severe on legumes.

Control of Paterson's curse growing in cereal crops can be obtained with lower rates as is the case with weeds in general under such conditions. With trials at Wongan Hills satisfactory results followed the low volume application of 12 oz. acid equivalent of 2,4-D amine per acre when the plants were at the rosette stage and up to eight inches across.

As a preventive measure, care should be taken to ensure that farm produce including hay and grain purchased from districts in which the weed occurs does not contain mature seeds. This precaution applies equally to other weeds.

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Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

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GOOD RESULTS WITH RED CLOVER AT DENMARK RESEARCH STATION

By F. E. RYAN, Agrostologist

◆

Stems of Red Clover at different stages of bloom.

MOST dairyfarmers are familiar with red clover under the name of Giant Colonial cow-grass, but only a few know that many strains of this valuable pasture and hay legume occur. One of the most promising of these strains is Montgomery red clover which is recognised as a grazing strain in England and New Zealand.

Very little red clover is grown at present in the dairying areas but much more of it was grown in the earlier days of settlement, particularly in the more southerly portions of the South-West. One reason for the decline in popularity has been the ease with which subterranean clover can be grown. Another reason is that red clover is susceptible to lucerne flea and red-legged earth mite, and, in the past, failures due to these pests have discouraged its use.

Now that suitable control of both mite and flea are available, the possibilities of red clover becoming more popular must be considered.

TRIALS AT DENMARK

The two strains, Montgomery red clover and Giant Colonial cow-grass, were sown at Denmark Research Station during the winter of 1954. Each was sown at the rate of 8lb. per acre. The paddock is a summer-moist one with sandy loam soil and pre-

Fig. 2.—Checking the depth of water penetration in the furrows on Cherrabun Plain.

The Kimberleys offer perhaps even more scope for achievement in this field of study than did Port Hedland. The country and the native species are similar, and the problems which have developed on most stations are the same. The history of stocking rates and pasture behaviour follows the same uniform pattern, with a steady expansion as new country was opened up, and a steep decline as these paddocks became over-grazed and new areas were not available for further spread.

Noonkanbah and Liveringa raced neck and neck for the honour of being the first station to produce 1,000 bales in one season. They went on then to produce between 1,000 and 1,500 bales each for a number of years.

Production however, has fallen away sadly since those days, and just as is the case in the North-West and Murchison, these areas now produce not much more than half the wool they did in their peak years.

But the Kimberleys have a higher rainfall, and a more reliable one than the lower North-West, and areas selected for regenerative treatment should respond even more readily. Certainly cattle country will be difficult to control, because fencing is so scarce, but the sheep stations of the area are well improved and are ready to apply corrective measures if they can be devised and demonstrated experimentally.

Several problems have already been defined and are now being tackled by Agricultural Officers in the Fitzroy region. There is no research station available but pastoralists are co-operationg with enthusiasm, and trials are under way on a number of leases.

Fig. 3.—A "scalded" area of the Margaret River frontage, Gogo Station. This was photographed during furrowing and fencing operations in November, 1955

Fig. 4.—This photograph, taken on the Margaret River frontage, Gogo Station, in May, 1956, shows the response of sown grasses (mainly buffel grass) in the furrow lines

1.—BARE AREAS OF RIVER FRONTAGE COUNTRY ON GOGO STATION

An area of river levee soil on the South bank of the Margaret River, was selected for regenerative treatment, commencing just prior to the wet season of 1955-56. The region had been almost bare of grasses for some years, although it was not in such bad straits as extensive nearby areas, where trees were dead and surface erosion visibly commencing.

Fig. 5.—Single-furrow mouldboard checker ploughing on Cherrabun Station. The ploughing was carried out in November, 1955, and was photographed after early summer rain

The experimental area was furrowed on a grid system, and some of the plots were sown to a mixture of introduced grasses. The whole area is fenced and will be later subdivided to enable grazing to be controlled in a manner designed to promote the best possible response from the more important pasture species.

This is our first attempt to study the behaviour of pastures under controlled grazing in the Northern cattle regions. Agricultural Adviser K. Fitzgerald is tackling the problem on a comprehensive basis, with enthusiastic and hard working assistance from Mr. A. Millard, Manager of Emanuel Bros.' stations in the Kimberleys.

In this instance we have chosen an area which we think will recover quickly. We want to get on with the control grazing observations just as quickly as we can.

2.—BARE SOIL ON SOUTH BANK OF FITZROY AT CHERRABUN STATION

This region is typical of some hundreds of thousands of acres of heavy clay soil which have been grazed continuously over the years of occupation of the Fitzroy Valley. Mr. Fitzgerald proposed a small trial to determine whether furrowing and protection from grazing might bring back

Fig. 6.—Re-seeding "scalded" country on Cherrabun Station, using buffel grass seed. Approximately 500 acres were covered with checker-board furrows two chains apart.

the ground cover as it has done on the claypan areas of Munda Station, and in typical style Emanuel Bros. went right ahead, enclosed four square miles of the plain with protective fencing and furrowed 1,000 acres of it.

This is a frightening-looking area, many square miles in extent, which Mr. Millard says has been bare of vegetation since 1928. It's probably the most difficult site that could have been chosen. An impression of the nature and extent of the problem is given in the photographs taken during operations in November last.

3.—AREAS JUST ABOVE RIVER PLAIN LEVEL AT MT. ANDERSON

Here grasses grow well but are themselves overgrown by a vigorous fast-growing spinifex of low palatability.

At Port Hedland, wherever the grasses thrive they manage to keep ahead of the spinifex, provided they are protected from stock during the short growing period. It then becomes a matter of grazing management to see that each paddock is periodically spelled at that very significant season. That this most certainly applies to large areas of the Kimberley spinifex too, has been well demonstrated by Mr. Jeff Rose at Quanbun. His spinifex country is in beautiful condition, and his system of burning a paddock and then spelling for the growing period of two successive years before he asks it to take over wet season duty again, ties up exactly with the Port Hedland lessons.

The Mt. Anderson spinifex however, does seem to present another problem, in that it comes back so much more quickly. Mr. Canny Rose has fenced off for us an area of 24 acres, subdivided into three paddocks, and here we are going to study the behaviour of grass and spinifex under different grazing routines and intensities, to see if a practical answer can be found. An encouraging point is that buffel and birdwood grasses and kapok bush, do well on this type.

4.—PINDAN COUNTRY OVERRUN BY CORKSCREW

Aristida Species.

This is a problem of major importance in the sheep areas of West Kimberley. Corkscrew is an annual which has progressively replaced the native perennials on sandy pindan soils. It may be significant that the problem is at its worst where stations have had to put their flocks on pindan paddocks each wet season because of flood danger on the frontage, and at its minimum in paddocks which have been spelled, as at Quanbun, to promote the perennial grasses.

It is to be a subject for study commencing this season. The grass is likely always to be a problem, but if an intimate study on a small area can determine what methods will minimise its menace, then it may later be possible to approximate these on a station management scale.

THE POLLINATION OF OHANEZ GRAPES

Results from Pollen-Water Spray Trials 1955-56

By C. R. HALE, B.Sc. (Agric.), and L. T. JONES, B.Sc. (Agric.), Plant Research Division

Fig. 1.—Ohanez grapevines trained on an overhead trellis at Belhus Vineyard, Upper Swan.

UNLIKE most other varieties of grape the Ohanez is not self pollinating, and before its fruit will set its flowers must receive pollen of another variety, i.e., it must be cross pollinated. Grower experience in the Swan Valley has been that interplanting of varieties with reliance on wind-borne pollen has not been satisfactory and, as a result, some form of hand pollination has been practised.

The pollination of Ohanez grapes by spraying the flowering bunches with a suspension of pollen in water was pioneered by Mr. A. R. Stevens and Mr. A. H. Convoy, two growers at West Swan, in 1939. The value of this method was confirmed by the Department of Agriculture (J. Dept. of Agric. W.A. XIX.: 210-213, 1942) and now the spraying method has largely superseded the method whereby Ohanez grapes were pollinated by rubbing the bunches with a sprig of flowers of the pollinating variety.

The advantages of the spraying method are:—

(1) a saving in labour costs and (2) an economical use of pollen when pollen supplies are low.

In the early investigations an examination of the behaviour of pollen in water indicated that it lost its effectiveness if kept in water for very long. Therefore it was recommended that, until further information was obtained, the pollen water mixtures should be used within several hours of preparation. In response to a request from the Export Grape Growers' Association, investigations were started last season to get more information on this subject.

The behaviour of Black Malaga and Muscat pollen has been investigated and some experiments were carried out on the properties of Mr. T. Barrett-Lennard, Upper Swan and Mr. R. R. Hyne, Millendon.

In these experiments bunches of Ohanez were covered with cellophane bags several days before flowering started. During the course of flowering the bunches were sprayed with pollen-water sprays which had been prepared for periods varying from under one hour to 24 hours. During flowering, each bunch received at least two sprays with the appropriately-aged pollen spray. Several days after flowering finished, the bags were removed and when the setting could be evaluated counts were made of the number of bunches which had set in each treatment. There were 20 bunches in each treatment.

It was found (see table below) that Black Malaga pollen lost its ability to set fruit after it had been in water for some time between three and six hours, i.e., it

Fig. 2.—Cleaning and packing Ohanez grapes at Belhus Vineyard.

is quite safe to use for three hours, and possibly a little longer, but how much longer is a matter for futher investigation. This means that if a pollen spray is prepared at say 8 o'clock in the morning then by 2 o'clock in the afternoon it is practically useless as a source of effective pollen. If pollinising is going to take all day, at least two mixtures should be prepared—one for the morning and one for the afternoon.

Effect of Time in Water on Setting Capacity of Pollen.

	Hours						
Age of Pollen Spray	0-1	1-2	2-3	4-5	6-7	8-9	24
Bunches Set	Per Cent.						
Black Malaga	44	65	75	*	5	5	0
Muscat	45	16	*	20	5	16	5

The setting with the Muscat pollen sprays was not good and the results cast some doubts on the suitability of this pollen for use in the spray method under the conditions of the experiment. Because neighbouring vines, which were pollinated by the rubbing method with the same type of pollen, set satisfactorily the poor setting in the experiment must be attributed to some effect of the experimental treatments. The cause may have been due to some reason other than the effect of water on the pollen and until more information is obtained, judgment on the suitability of Muscat pollen for use in the spray method, must be suspended.

Little definite information can be given on what are suitable pollen varieties for use in the spray method. Tests have been carried out on Black Malaga, Muscat, Purple Cornichon, Wortley Hall and Bridal. The results with Black Malaga and Muscat are described above. Purple Cornichon and Wortley Hall can be used, but there is no information on the length of time the pollen remains effective. Bridal is not satisfactory.

Other varieties have been used with apparent success by growers, but in con-

* No sprays applied.

Fig. 3.—An overhead trellis of Ohanez grapevines in the Swan Valley.

sidering these reported results the effect of wind-borne pollen must not be overlooked. It is possible that in many circumstances wind-borne pollen is sufficient, but, because it cannot be relied upon every season and through all the flowering period, hand pollination has to be carried out so that there is no possibility of crop failure through lack of pollination.

SUMMARY

Experiments carried out in the 1955-56 season showed that the life of pollen in pollen-water sprays was limited. Black Malaga pollen was effective for at least three hours. Muscat pollen apparently lost its effectiveness to a much greater degree. The reasons for the inferiority of Muscat pollen are unknown and further trials are proposed.

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LINCOLN — WORLD'S LARGEST MANUFACTURERS OF ARC-WELDING EQUIPMENT

Post-War Trends In The Citrus Industry

By F. MELVILLE, B.Sc. (Agric.), Senior Adviser (Fruit).

THE citrus industry in Western Australia in terms of acreage and production is third in magnitude to pome fruits and grapes. At the present time there are in the vicinity of 390,000 citrus trees planted in commercial orchards in the recognised citrus districts, producing up to half a million bushels per annum. Of the total number of trees 80.7% are oranges; 11.6% lemons; 4.6% grapefruit, and 3.1% mandarins. Production of fruit follows a somewhat similar pattern, except that the proportion of oranges is somewhat less and that of lemons considerably greater than that shown by the number of trees.

During the war years, although citrus growers were able to dispose of their fruit satisfactorily for factory use, due to the demand for citrus juices by the services, orchards generally declined due to lack of attention resulting from shortage of labour and materials. At the conclusion of hostilities the industry was faced with an extensive rejuvenation and replanting programme to return it to anything like pre-war level. The replacement programme was hampered by a shortage of nursery trees, and shortages of materials such as fertilisers and equipment persisted for some time.

In the early post-war years a very useful market opened up in Singapore and, as early as 1946, over 50,000 bushels of oranges were exported. However, the prospect of this new outlet for citrus fruits and the increasing local demand, was insufficient to induce any great expansion even when trees became available in adequate quantities. Large-scale plantings such as occurred under War Service Land Settlement Schemes in other citrus areas in Australia were not considered warranted. In the period which has elapsed since the war, a gradual increase in citrus plantings has taken place, amounting to approximately 6%.

In the meantime, exports of citrus fruits, and particularly oranges, have slowly declined, but have been more than offset by the increased local demand created by a 29% increase in population and greater purchasing power.

In the following discussion of the trends in area and production of citrus fruits, figures supplied by the Government Statistician covering the main commercial citrus areas have been used, covering the ten year period 1945-1954. In the graphical illustrations, figures for 1955 have also been included.

The citrus districts have been grouped into zones of similar climatic and growing conditions, as by this means it is possible to give a clearer picture of what has taken place. These zones consist of Northern, Coastal, Hills and Southern. The Bindoon-Chittering area comprises the Northern zone; the coastal strip from the Swan Valley to Pinjarra is termed Coastal; and Southern consists of Harvey, Donnybrook and Capel. The Hills zone, as the name suggests, takes in all the Hills districts. It has not been possible in some cases, to define the zones exactly, due to the overlap of certain Road Board areas into more than one zone. For instance Maida Vale-Forrestfield could not be separated from Hills, nor Roleystone-Bedfordale from Coastal, but to some extent they compensate each other.

AREA OF VALENCIA ORANGES

Practically the whole of the increase in citrus plantings which has taken place since the war has been due to new plantings of Valencias. Growers have shown a decided preference for Valencias, so much so that in the ten year period 1945-1954 plantings rose from 143,800 to 191,500

trees, an increase of 47,700 trees, or 33.2%. The effect of the new plantings is reflected in the proportion of non-bearing trees which remained at a high level throughout this period and in 1954 stood at 18.9%.

This interest in Valencias has extended to all districts, although the degree of planting has varied considerably. A comparison of the four zones is given in Table 1 and depicted graphically in Fig. 1. Of the total increase in Valencias, the Northern zone accounts for 46% followed by Coastal and Hills with 21% each and Southern with 10.5%. It is noteworthy, that although the Coastal zone contains a slightly greater area of Valencias than Northern, the increase in acreage is less than half.

AREA OF NAVELS

In contrast to Valencias, Navel orange plantings have decreased considerably. From 153,400 trees in 1945, plantings have dropped to 134,600 trees in 1954, a decline of 18,800 trees, or 12.2%. Nevertheless the proportion of non-bearing trees during this period averaged about 10%, indicating that Navels have been consistently planted, but in numbers insufficient to balance the old orchards going out of production.

Looking at the changes from a district point of view, the major decline has taken place in the Coastal area—(Table 1 and Fig. 2) where 47% of the total decrease has occurred. A very slight increase is apparent in Northern districts, but elsewhere the trend has been downwards.

Table 1

Acreage and Production of Oranges

Zone.	VALENCIAS.				NAVELS.			
	Percentage of Total Planting.	10 year Increase in Plantings.	Percentage of Total Increase.	Average Production per 100 bearing trees, 5 year period 1950–1954.	Percentage of Total Planting.	10 year Decrease in Plantings.	Percentage of Total Decrease.	Average Production per 100 bearing trees, 5 year period 1950–1954.
		trees.		bushels.		trees.		bushels.
Northern	29·4	22,000	46	122	29·5	....	....	136
Coastal	30·1	10,000	21	155	28·4	9,400	54·1	144
Hills	21·5	10,000	21	135	32·6	3,800	21·9	138
Southern	17·8	5,000	10·5	160	7·8	4,900	28·3	140

Table 2

Percentage of Non-Bearing Trees

Year.	44–45.	45–46.	46–47.	47–48.	48–49.	49–50.	50–51.	51–52.	52–53.	53–54.	54–55.	Annual Planting Rate, 1950–54.	Anticipated Replacement Period.
												%	Years.
Navels	11·0	7·8	6·2	6·4	8·7	10·3	13·1	12·4	11·8	9·4	9·5	2·2	45
Valencias	17·7	15·8	12·5	12·1	18·6	10·3	24·4	22·5	23·2	18·9	17·6	4·2	24
Lemons	15·3	10·2	9·1	10·3	14·3	13·5	15·3	15·2	14·9	12·9	12·1	2·8	36
Grapefruit....	19·2	15·0	9·3	8·9	12·4	8·9	8·7	14·0	7·4	4·7	4·3	1·6	63
Mandarins....	16·2	14·2	8·0	11·9	13·3	16·9	20·5	23·4	21·7	16·9	16·2	3·9	26

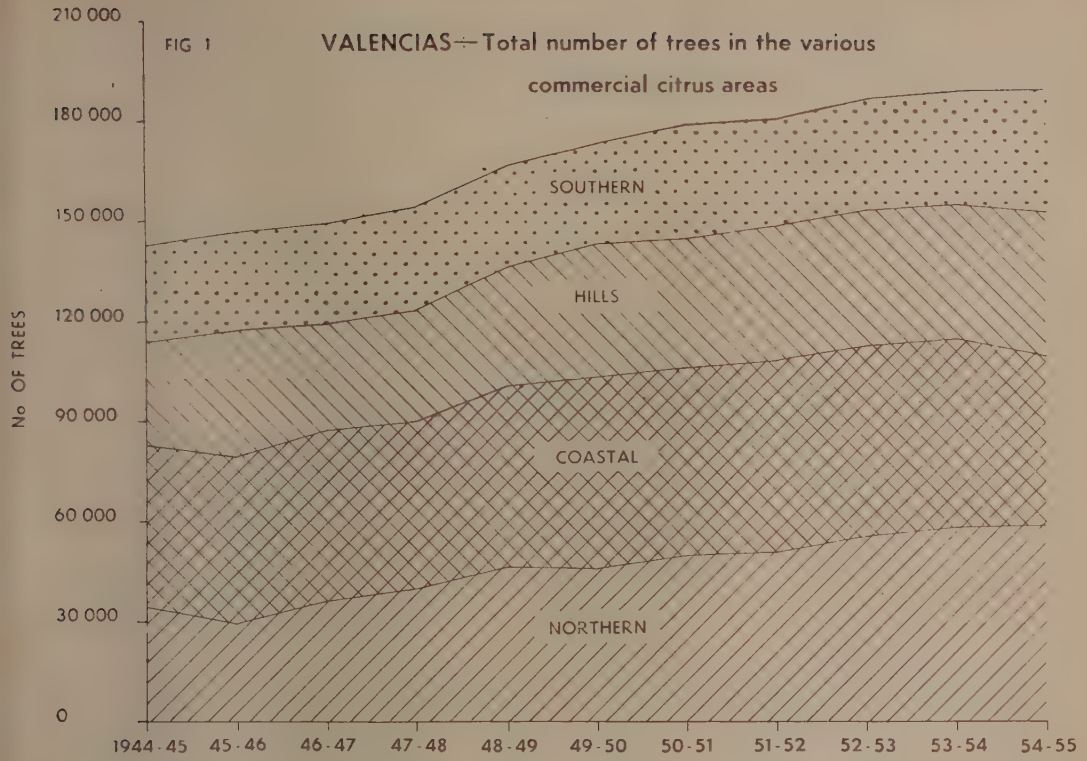


FIG. 1
VALENCIAS—Total number of trees in the various commercial citrus areas
210 000
180 000
150 000
120 000
90 000
60 000
30 000
0
No OF TREES
SOUTHERN
HILLS
COASTAL
NORTHERN
1944-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55

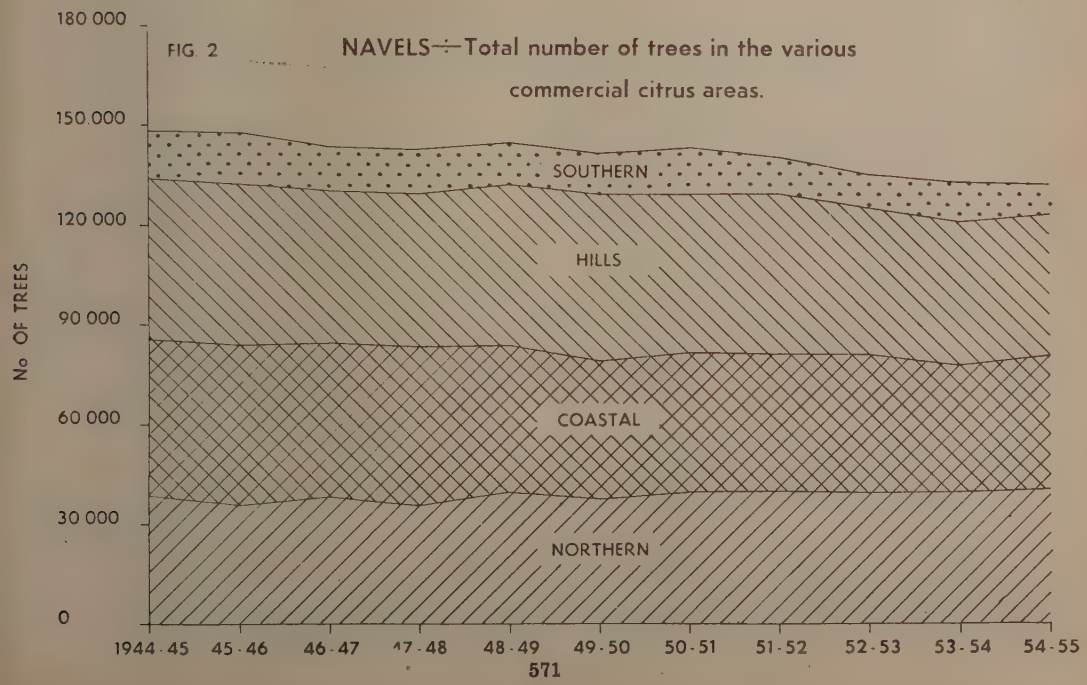
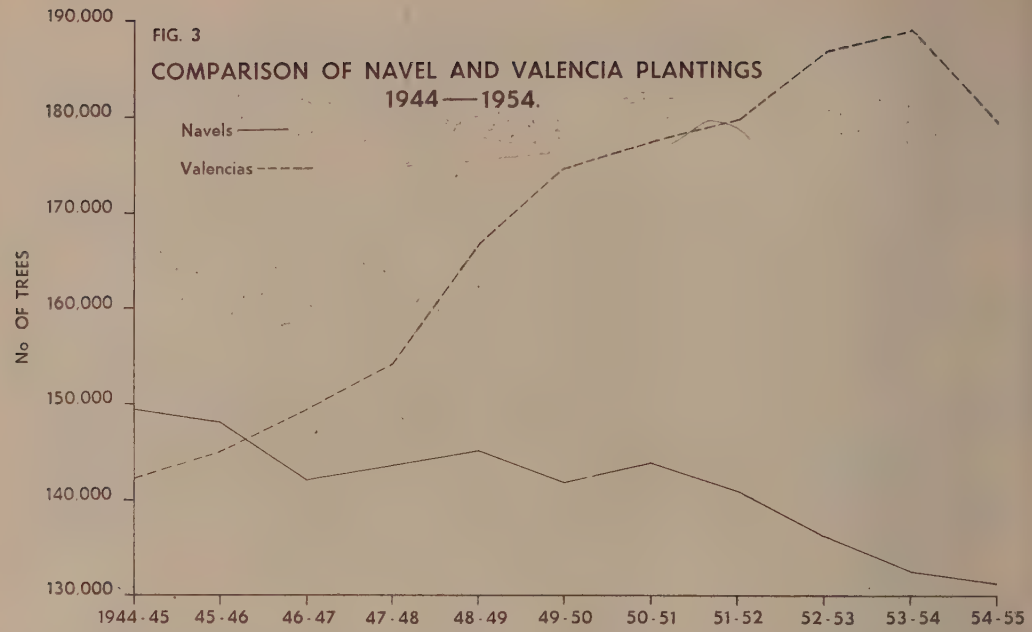


FIG. 2
NAVELS—Total number of trees in the various commercial citrus areas.
180 000
150 000
120 000
90 000
60 000
30 000
0
No OF TREES
SOUTHERN
HILLS
COASTAL
NORTHERN
1944-45
45-46
46-47
47-48
48-49
49-50
50-51
51-52
52-53
53-54
54-55



The decided preference for Valencias has brought about a radical change in the proportion of these two orange varieties, as shown in Fig. 3. In 1954 there were 8% more Navels than Valencias, but by 1954, there were 43% more Valencias than Navels. The reason for the swing to Valencias is no doubt related to the relatively higher prices which have operated for this variety on the local market, coupled with more congenial harvesting and a longer marketing period. With Navels the harvest period is short and there is always the hazard of excessive fruit drop during mid-winter.

PRODUCTION OF ORANGES

The production of both Valencias and Navels varies considerably from year to year as is evident from Figs. 4 and 5. Perhaps the most outstanding feature is the very decided effect seasonal variations have on production. It will be noted that both Valencias and Navels show the same upward and downward seasonal trend and this is also reflected in each zone. In other words, a good year for Valencias tends to be good for Navels and vice versa. Generally speaking, in a good year, the production in all districts is up and in a light year, all areas show a downward trend.

Valencia production has gradually increased since 1945 and at present is approximately 20% greater than it was ten years ago. Expansion has taken place in all four zones, but the greatest increase has occurred in the Northern areas. With over 19% of trees still non-bearing, further increases in Valencia production can be expected.

The position with Navels is rather different. Although plantings have decreased considerably, there is very little, if any, corresponding fall in production. Production in Coastal areas appears to be declining, but so far this has been made up by increases in Northern districts. The decline in plantings indicates that new areas are insufficient to balance declining orchards and some reduction in Navel production can therefore be expected in future years.

At what level a new balance between Valencias and Navels will be struck cannot be determined, but with increasing home consumption and the possibility of declining Navel production a stage must be reached when greater interest will be taken in Navel plantings.

FIG. 4

PRODUCTION OF VALENCIAS IN THOUSANDS OF BUSHELS

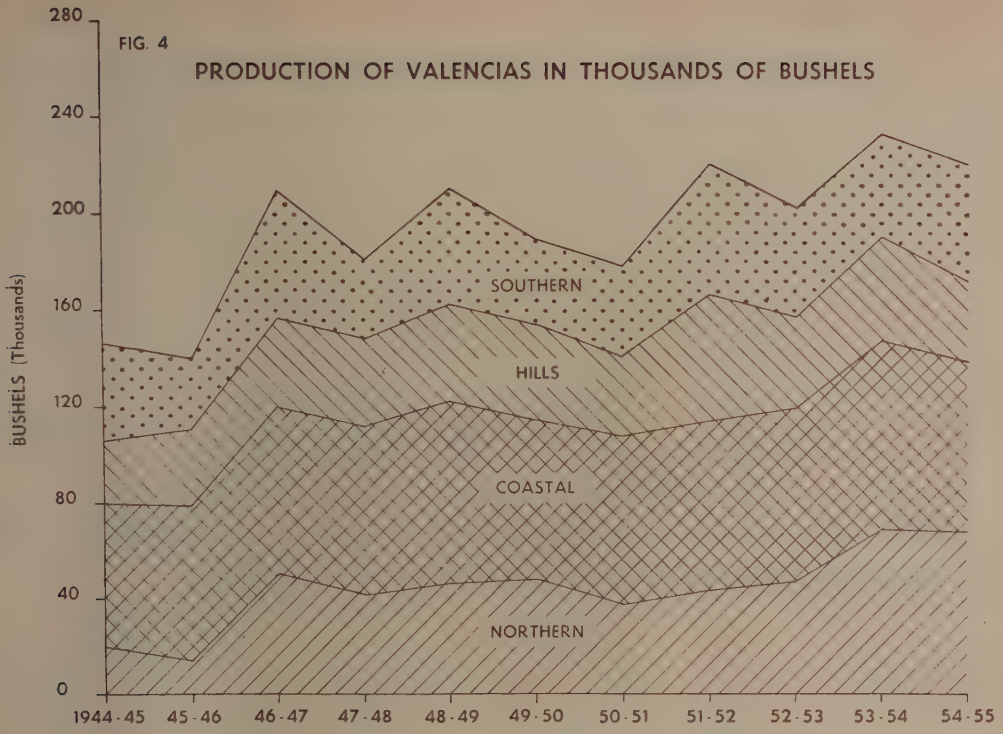
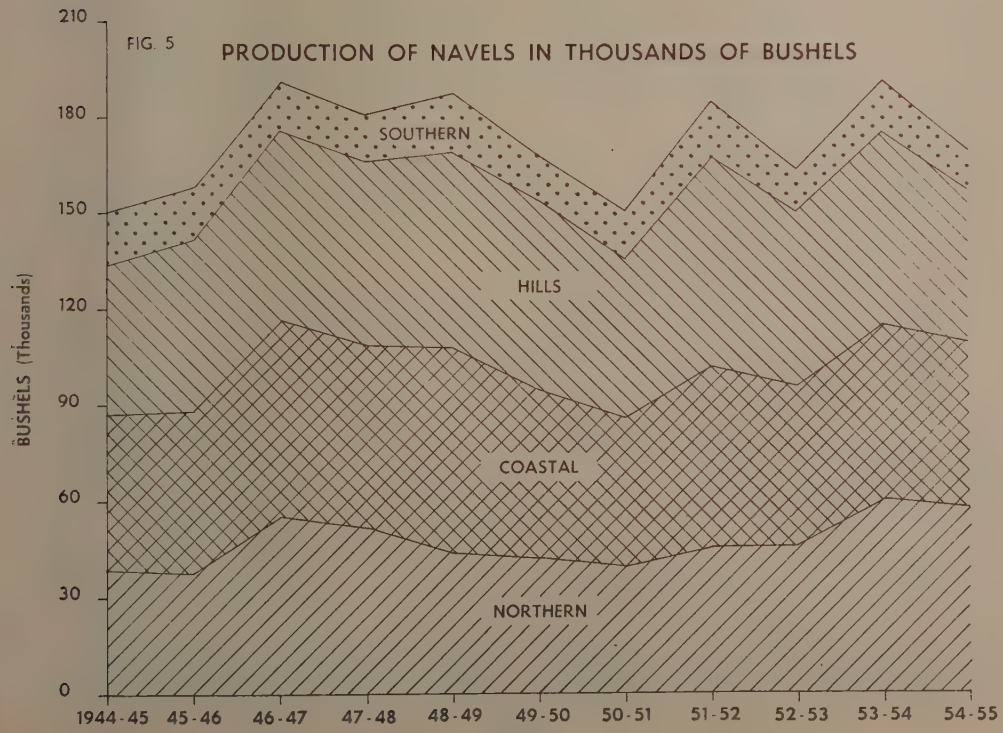


FIG. 5

PRODUCTION OF NAVELS IN THOUSANDS OF BUSHELS



ORANGE YIELDS

In Table 1 are shown for each zone, the average yields per 100 bearing trees for the five-year period 1950-1954. The yields of both Valencias and Navels are lowest in the Northern zone. This may be related to the absence of summer irrigation, although in the case of Valencias the greater proportion of younger trees may also be a factor. Yields are highest in the Coastal and Southern areas and intermediate in the Hills. Tree size is probably a factor in the high yields in Southern areas.

LEMONS

Lemon acreage has changed very little in the period since the war. At the end of the war, production was adequate to meet requirements and in the intervening years, the increased demand has been insufficient to induce growers to increase plantings. The rise in population has increased consumption, but probably not proportionately, due to the increased plantings of lemons in home gardens. A useful export trade has been developed with Singapore, but the greatest quantity shipped in any one year is 7,600 bushels. Factory prices for lemons have also in the main been unattractive and have provided little incentive for increased plantings.

In the years prior to 1949 a slight upward trend was noticeable in lemon acreage, but since then the trend has been in a downward direction and in 1955 plantings were only slightly above the post war level. This is shown graphically in Fig. 6 which also gives the distribution of plantings. It will be noted that the majority of lemon orchards are located in the Coastal (42.7%) and Hills (44.3%) areas. The Northern and Southern zones contain only 6.2% and 7.5% respectively. The proportion of non-bearing trees has remained in the vicinity of 12-15% during much of the post war period, but the planting rate has been sufficient only to maintain acreage.

Lemon production has varied considerably from year to year, i.e., from just under 81,000 bushels to over 106,000 bushels. This large seasonal fluctuation makes it difficult to assess the trend in production and so far no clear-cut picture is apparent. The light crops experienced recently may prove to be at least in part due to general decline in production. Approximately 90% of the lemons are produced in the Coastal and Hills areas.

GRAPEFRUIT

The demand for grapefruit has never been such as to encourage large plantings of this fruit. Although the total area has fluctuated, the general tendency is in a downward direction as indicated in Fig. 7. The decline is apparent in all zones and is emphasised by the decrease in non-bearing trees which has occurred. In 1955 only 4.3% of trees were non-bearing, as against 19.2% in 1945.

The Northern zone contains 42.5% of grapefruit plantings, Coastal 24.6%, Hills 22.5% and Southern 10.4%.

The effect of decreasing acreage is not as yet reflected in production figures and in recent years crops have tended to increase rather than decrease. Seasonal fluctuations are, however, considerable and any attempt to define the trend could be misleading. Almost 50% of grapefruit production has in recent years come from Northern areas. Coastal is next, closely followed by the other two zones.

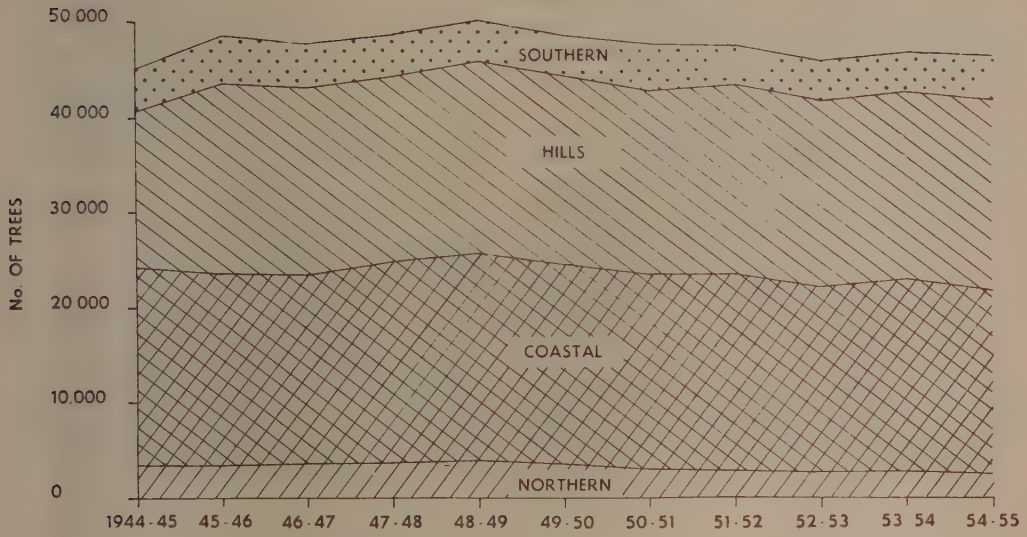
MANDARINS

Mandarins are grown mainly in the Coastal zone (45%) and Northern areas (31.4%). The Hills zone contains 15.2% of plantings and Southern 8.0%. In 1955 the total plantings amounted to 18,738 trees. Considerable interest has been shown in mandarins since the war and increased plantings have occurred in all zones with the exception of Southern (Fig. 8). There are now nearly 25% more trees than in 1945 but this does not constitute a very large quantity. Most of the increase has occurred in Coastal and Northern areas. As would be expected, the proportion of non-bearing trees has remained at a fairly high level.

Mandarin production fluctuates more than any other citrus fruit—the highest production being 60% greater than the lowest. Owing to the wide variation from season to season, it is not possible to determine the overall trend.

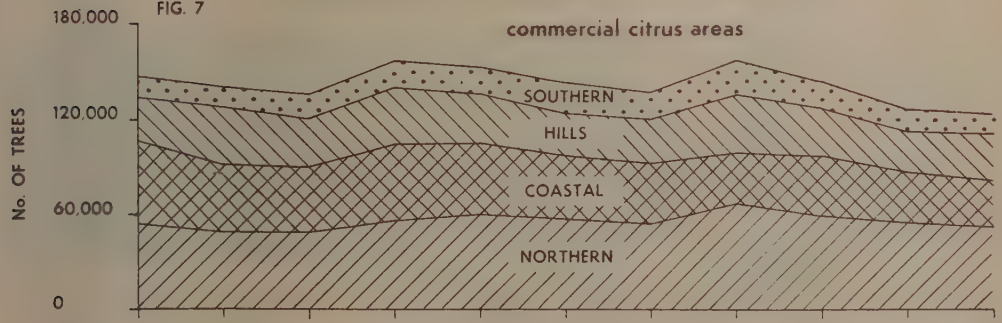
LEMONS—Total number of trees in the various commercial citrus areas

FIG 6



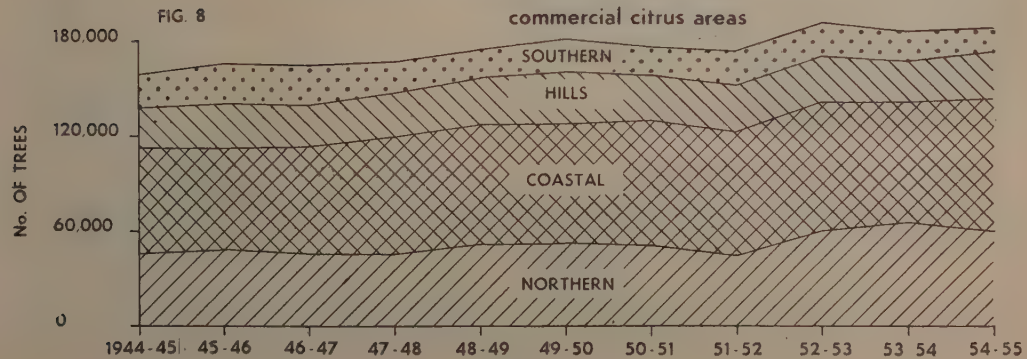
GRAPEFRUIT—Total number of trees in the various commercial citrus areas

FIG. 7



MANDARINS—Total number of trees in the various commercial citrus areas

FIG. 8



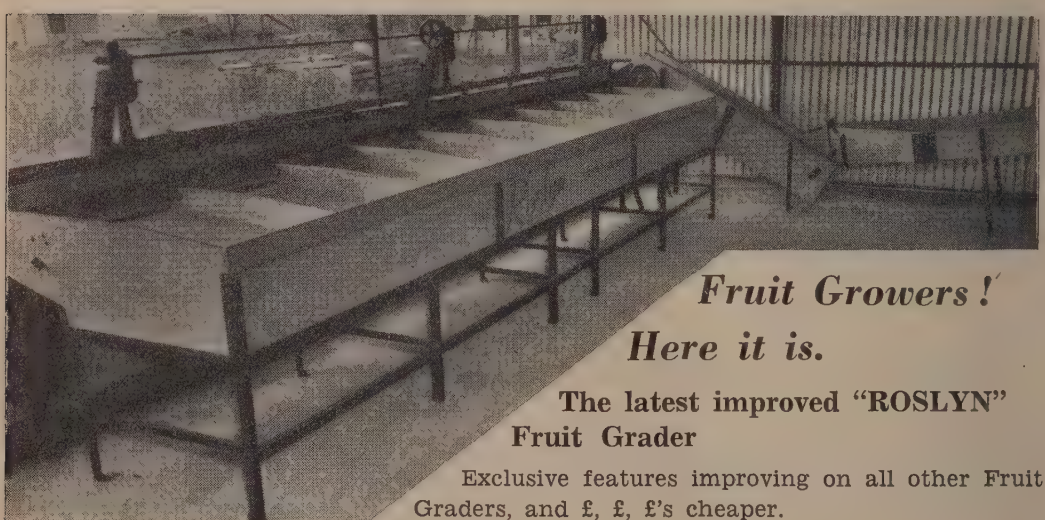
FUTURE TRENDS IN CITRUS PLANTS AND PRODUCTION

Some indication of possible future trends in the citrus industry can be obtained by a study of the percentage of non-bearing trees as shown in Table 2. It will be noted that Valencias have the highest figure, closely followed by Mandarins. Non-bearing Navel trees are proportionately only half that of Valencias, non-bearing lemons about two-thirds, while the figure for grapefruit in the last few years has dropped to a very low level.

If it is assumed that non-bearing trees are five years of age or less, then the average planting per annum may be calculated as shown in the second last column of Table 2. On this basis, the period required for the complete replacement of existing plantings is shown in the last column.

The planting rate for valencias and Mandarins appears adequate to replace existing plantings and allow for some expansion. However, the present planting rate for Navels, lemons and grapefruit appears inadequate to maintain plantings of these fruit at present levels, and as existing orchards go out of production acreage would be expected to decline.

The effect on production is not so easy to discern, owing to the large seasonal fluctuations which occur in all citrus fruits. However, bearing in mind the present position of plantings and particularly the proportion of new plantings over recent years, it is anticipated that the production of Valencias and mandarins will increase. Navel and grapefruit production can be expected to fall and lemons will also probably show some decline.



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(b) The South-West Land Division of the State.

(c) Such parts of the Lake Grace, Merredin, Narembeen and Phillips River road districts that are outside the South-West Division.

All cattle in districts other than those described above must be branded before they attain the age of 18 months.

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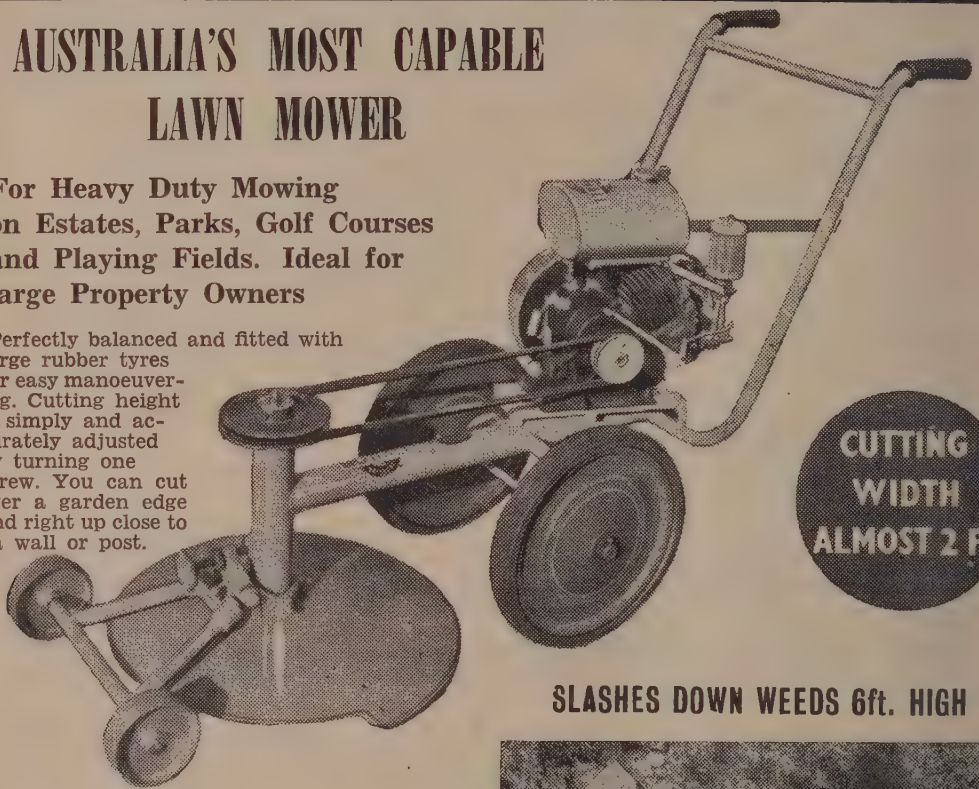

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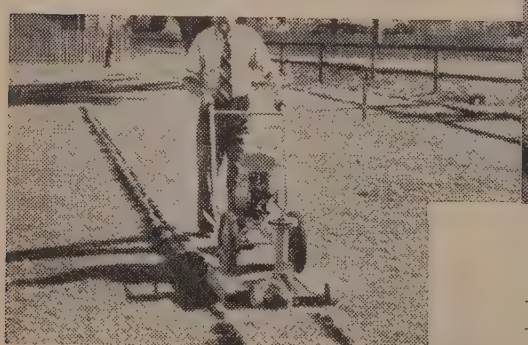

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"CLOVER DISEASE" OF SHEEP IN WESTERN AUSTRALIA

By H. W. BENNETTS, D.V.Sc., Principal, Animal Health and Nutrition Laboratories

FROM about 1940 onwards, an infertility in ewes, together with other breeding troubles and abnormalities of the sex organs of sheep, became a very serious problem in certain regions of Western Australia where the pastures were composed predominantly of subterranean clover.

The introduction of this plant has been responsible for enormous increases in the general productivity of large areas of country in Western Australia, mostly in districts where the climatic and other conditions have proved especially favourable to domination of the sward by subterranean clover, particularly during the earlier years of pasture improvement.

This "clover disease," as it came to be called, was at first thought to be restricted to Western Australia. Later, however, it was recognised in some other parts of the continent, again in association with subterranean clover-dominant pastures.

The cause of the disease was determined and various aspects of the problem have been studied by a large number of workers both here and elsewhere. The results of these investigations have been published in a series of technical papers, many of which are cited by Shier and Rossiter (1949) in an article entitled "Clover Disease. Practical Findings and Recommendations for Control." That article, revised and again issued in leaflet form in 1955, enumerates the factors responsible for the disease, indicates the essential effects on the animals, and details practical recommendations for control which are based on current knowledge of the disease.

The purpose of the present article is to give a more detailed account of the cause, effects, and occurrence of the disease and to bring up to date the information published in this Journal by Bennetts, Underwood and Shier (1946).

CAUSE

The various manifestations in the ewe and the wether which collectively are described as "clover disease" are all due to one cause, the consumption of excessive quantities of subterranean clover at certain stages of growth. This occurs when sheep are maintained on green pastures which are dominated by this clover (*Trifolium subterraneum*).

It has been demonstrated that the clover contains a potent substance which has an action on the sheep identical with that of one type of sex hormone known as an oestrogen. The sex hormones are chemical substances produced normally by certain glands in the animal body, and together they control and maintain the various reproductive processess and organs. If the sex organs are, for long periods, exposed to the action of excessive amounts of one type of hormone, the normal hormone balance is upset and gross abnormalities may result. This is what happens when sheep over long periods ingest a diet which contains a high proportion of green subterranean clover.

Extensive experimentation over a period of years has shown that the clover contains a potent substance and produces in sheep and in laboratory animals effects which are identical with those induced by known oestrogens; the effects on ewes of prolonged diets of potent clover and of prolonged treatment with a known oestrogen (stillboestrol) have also been compared and found to be essentially the same.

It has been demonstrated that subterranean clover may be "dangerous" from germination up to wilting time, after which there is a rapid fall in potency (this is not due to drying but to stage of growth). Dry

clover and clover hay **cut at the normal time** can therefore, be eaten by sheep with impunity.

It seems evident that any known strain of subterranean clover could cause trouble; Curnow and Rossiter (1955) reported that over 120 strains examined were found to contain appreciable concentrations of the oestrogen (genestein). A number of different pasture plants including other clovers have been examined with almost consistently negative results.

Fig. 1.—Prolapse of the uterus in a ewe suffering from clover disease.
(By courtesy of H. T. Carroll)

It should be borne in mind that in the case of the ewes the effects of subterranean clover grazing are progressive and cumulative. Even one season's grazing of green clover may induce signs of the disease in some individuals but the numbers affected and the severity of the effects increase progressivley with the years.

Chemical examination of extracts of potent clover finally resulted in the isolation of a substance, genistein, which is believed to be the active principle or "oestrogen."

EFFECTS

1. Ewes.

Ewes may be affected with "dead lamb disease" or dystocia; they may be infertile or fail to get in lamb, and they may show prolapse of the womb; maiden or dry ewes not uncommonly show marked udder or teat development and milk secretion. In some instances, ewes may show an abnormality known popularly as "high tail."

Dead Lamb Disease—In some instances lambs are carried to full term but are born dead or are weak and die soon after birth. Not uncommonly this is the first evidence of the appearance of "clover disease" on the property and may be the only manifestation noted during the first season.

More commonly, however, a number of ewes are affected with a type of dystocia, or difficult birth, which generally results in death of the lamb and death or wastage of the mother (up to 30 per cent. loss of breeding ewes). The signs of this dystocia, a result of uterine inertia, are characteristic of clover trouble. The condition differs from the familiar type of difficult birth, not uncommonly affecting a small percentage of ewes, which is usually due to abnormal size or position of the lamb. In "clover disease" the maternal dystocia is characterised by the apparent absence of labour and failure of the ewe to show concern or discomfort prior to the advent of complications resulting from the death of the unborn lamb.

Towards the end of the in-lamb period the appearances of the body and a degree of udder development indicate that the ewe is pregnant or due to lamb. At term, however, there is only a feeble and brief period of labour, frequently when the ewe is in the standing position. This results only in rupture of the "water bag" and escape of the foetal fluids. Following this

almost momentary attempt at lambing no further effort is apparent, and the ewe unconcernedly rejoins the flock.

Quite commonly there is no external evidence of the foetus at this stage and very careful and prolonged observations are necessary to find these early cases in the paddock; delivery is then accomplished relatively easily although the lamb, in most instances, is already dead.

In general however, the ewe is not noticed to be in trouble until some days later when the feet or portion of the head of a dead lamb may be seen protruding from the passage. Other signs are a humped attitude, occasional straining, the presence of an udder greatly distended with milk and, not uncommonly, attempts to foster young lambs. At this stage the foetus is generally decomposed, the womb is dry and has contracted so that delivery is accomplished only with difficulty. Prolapse of the uterus is a not uncommon sequel and in any event the ewe is a poor prospect for future breeding.

Ewes affected with dystocia may not be noticed until some weeks or months after they should have lambed when the flock is brought in and handled. The signs then noted are a putrid discharge from the passage, poor condition, abnormal posture and occasional straining. In some cases there is no obvious abnormality but the presence of a mummified foetus may be detected by palpation through the body walls.

We have seen then that affected ewes may give birth to dead full-term lambs or may fail to deliver their lambs. It is considered that both manifestations merely represent different degrees of maternal dystocia resulting from inertia of the womb and leading to death of the full term foetus because of delayed lambing or failure to lamb. Uterine inertia, or loss of muscular power of the womb, is doubtless related to the effects of the clover oestrogen.

These manifestations are seen most frequently when clover disease first appears on a property, and when (as in 1943 and 1955) there is an early break in the season which results in ewes being on green clover pasture for the greater part of their pregnancy. Subsequently, within a year or two, the main problem is not dystocia but infertility.

Infertility—The infertility has no characteristic features. In a ewe flock maintained on clover dominant pasture there is a progressive increase in the number of ewes which fail to get in lamb so that within some four or five years the lambing percentage may fall to below 10 per cent.

Fig. 2.—An abnormally-developed teat from a wether affected with clover disease. It contained ½ oz. of milk.

Extensive experimental observations have shown that there is no failure of heat. The ewes come in to service, more or less regularly, but fail to get in lamb. It seems most probable that the ewes do not conceive because of the abnormal condition of the womb (uterus). In that connection, the naked eye and microscopic examination of the breeding organs of large numbers of ewes from affected properties revealed the common occurrence of a cystic condition of the uterus (cystic endometrium).

This abnormality, a characteristic effect of the prolonged action of an oestrogen, was found to be generally present in a large number of infertile ewes examined from many affected properties. The cystic condition becomes progressively more severe with the time on potent clover. In a few individuals, even one season's grazing on clover-dominant pastures may lead to a degree of abnormality. The effects are almost always permanent—an infertile

ewe remains infertile despite being transferred to non-clover grazing—the cystic condition of the uterus once established remains.

The cysts referred to can be seen on the inner surface of the uterus, they may be few and microscopic or they may be very numerous and easily seen by the naked eye, being then from about 1/25th to 3/5th of an inch in diameter.

Prolapse—The condition referred to as prolapse occurs generally during the spring months. It may affect up to about 10 per cent. of the flock, both bred and unbred ewes being susceptible. The process involves a turning inside-out of the womb and it is this inverted uterus which is prolapsed. The condition may proceed to a more or less complete inversion of that organ.

The earliest stage revealed by careful observation of the flock is that of a ewe lying down, bleating and straining as though attempting to lamb. This is followed by the early appearance of the prolapsed uterus and a cessation of any marked straining. Affected animals, however, are rarely noticed until the prolapse is obvious externally and we personally have seeh very few cases at an earlier stage. The condition develops progressively until, within a week or two, the body of the uterus is completely, and the horns partially, inverted. The prolapse then projects from the body as a swollen tube up to ten inches long by three inches in diameter, terminating in partially inverted horns. The exposed lining of the organ is highly inflamed and red but later becomes grey, eroded and dead. The initial swelling and enlargement of the organ then subsides.

Affected animals are usually slaughtered when found. If not they may survive for months or die from infection, toxaemia, or from the effects of rupture of the prolapse. Attempts at replacement of the prolapsed organ and its fixation by various methods adopted by sheep-owners are rarely successful. This is to be expected in view of the great stretching and weakening of the supporting ligaments.

Spontaneous "recovery" is known to occur but it is doubtful if the "recovery" is permanent; recurrences have been seen some months later in such cases and it is suspected that they are not uncommon. It is difficult to understand how a well-developed prolapse could really recover.

"High Tail"—A percentage of ewes which have been maintained on subclover pastures may show this condition which is now widely recognised by sheep owners and purchasers. The apparent elevation at the base of the tail is actually due to a displacement (rotation) of the pelvis, which becomes lowered behind as a result of relaxation of the pelvic ligaments that normally hold it in position. This effect results from the action of the clover oestrogen.

In advanced cases of "high tail," manipulation of the region in front of the base of the tail may elicit a grating of bone which may be both felt and heard. This grating (or crepitus), results from a displacement of the sacro-iliac articulation.

The presence of "high tail" does not seem to affect the health of the ewe but does indicate that it has received an excessive intake of subclover, and in consequence, is most probably infertile.

2. Wethers.

Wethers grazing pastures dominated by subterranean clover may show two obvious abnormalities, namely lactation and "false bladder." Both these conditions result from the stimulation of accessory sex organs by the clover oestrogen. The effects produced are of great scientific interest although, relatively, not of any serious economic importance.

Lactation in Wethers—This was first brought to our notice by reports from a number of clover-dominant properties where in the spring months of 1942, and 1943, it was stated, "shearers were squirting milk on the board." On one property, in 1942, it was estimated that about 300 wethers, of 3,800 carried, showed some evidence of lactation.

We had no opportunity of investigating this unusual phenomenon until October 1945, when a number of affected wethers were examined on several properties. Subsequently the condition was commonly noted in the field and was seen also in experimental wethers maintained on clover grazing or treated with a synthetic oestrogen (stillboestrol).

The condition is characterised by a more or less marked development of the teats, with secretion into a closed space bounded by the teat wall and above by a lid, or capsule, which covers the base of the teat; there is no udder development, but milk is secreted by tissue lining the teat wall. It may resemble ewe's milk in appearance and has a similar chemical composition.

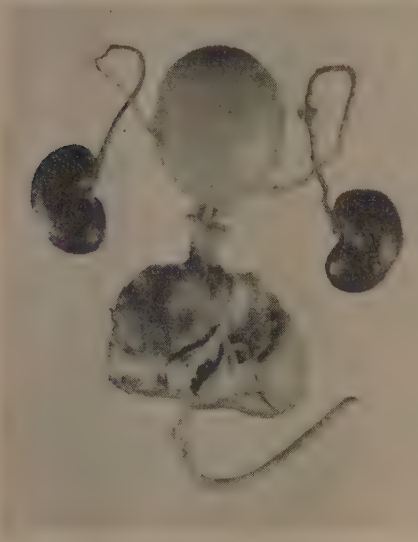

Fig. 3.—"False bladder." Urinary organs of a wether affected with clover disease, showing the greatly enlarged bulbo-urethral glands.

The degree of teat development may correspond to that of a ewe in full lactation, e.g. in one case the teats were 2½in. long by 2in. in diameter at the base.

False Bladder — This extraordinary phenomenon consists essentially of an almost incredible development of what appears to be a new organ in the form of a large sac communicating with the urethra (the tube leading from the bladder to the penis) and which thus becomes filled with urine.

This sac, up to 6in. in diameter, lies on top of the urethra and may almost fill the cavity of the pelvis. When the sac is well developed it is obvious externally as a large fluctuating swelling which may bulge out of the whole region of the crutch below the anus. In some cases this sac may rupture through the skin and, particularly when the normal passage is blocked as a result of "clover stones"* or inflammation etc., the urine may be voided from this opening in the lower portion of the crutch.

The condition becomes apparent during the spring months. The signs are loss of condition, swelling in the crutch and evidence of straining and pain. In advanced cases wethers do not survive for many weeks; they lose condition rapidly and die as a result of infection or urinary obstruction. Less severely affected animals may recover; others are affected to such a slight degree that they show no signs of ill health, and abnormalities caused by the clover oestrogen can only be detected by a careful post-mortem examination by a trained observer.

We have shown (Bennetts 1946 and 1947) that the "false bladder" develops from a pair of small glands (bulbo-urethral) which are situated on the upper surface of the urethra. Briefly as a result of continued stimulation from the clover oestrogen these glands are profoundly altered in character; they greatly enlarge and become cystic, and in extreme cases the whole structure of the glands breaks down forming a large cyst or sac which becomes filled with urine.

The percentage of wethers showing recognisable clinical evidence of "false bladder" rarely exceeds 2 per cent. and the mortality rate would be even lower.

In sharp contradistinction to the effects induced in the ewe the abnormalities seen in the wether are not permanent. The teat development, lactation and the changes in the bulbo-urethral (and prostate, etc.) glands are progressive while the animals are eating potent green clover. When the oestrogenic stimulus is removed, however, these abnormal developments are checked and the affected organs or tissues return to their normal condition (that is with the fall of potency of the clover after wilting and through the dry feed period).

---

* "Clover Stones."—The common occurrence of calculi in the kidneys of sheep associated with grazing of subclover has been reported in this Journal by Bennetts (1950). These calculi, which may be quite large, are sulphur yellow in colour and are very soft and friable. Small stones or fragments may reach the lower urinary tract and in the male, cause obstruction and "water belly."

3. Rams.

The fertility of the ram is not impaired as a result of grazing subclover dominant pastures, nor does the ram exhibit any of the abnormalities described in the wether. The ram seems to be entirely insusceptible to the effects of the clover oestrogen. There is experimental evidence to support the claim that this insusceptibility results from the protective effect of the male sex hormone (testosterone) which is secreted by the testicle of the entire male. (The actions of the "male" hormone are in many respects antagonistic to those of the "female" hormone, oestrogen).

OCCURRENCE AND CONTROL

"Clover disease" became a very serious problem in this State subsequent to 1940, following a period of intensive pasture improvement with the early Dwalganup strain of subterranean clover. As we have seen the disease results from an excessive intake of subterranean clover, and the effects on ewes are cumulative and permanent.

The serious situation which developed here was undoubtedly in the main due to the following factors:—

(a) A local environment so favourable to the clover that it tended to dominate the pastures, particularly in the early stages of development,

(b) The concurrence in three years, 1942, 1943 and 1944, of seasonal conditions which favoured this dominance and, notably in 1944, an unusually long green growing period. The cumulative effects of these seasons were felt for many years.

Subsequently an understanding of the nature and cause of the disease provided a basis for control. Recommendations for an appropriate system of farm and sheep management have been detailed by Shier and Rossiter (*loc. cit.*) and will not be repeated here. Briefly the object is to prevent ewes from regularly eating excessive amounts of green subterranean clover, of any strain—cattle and horses, however, may graze it with impunity. Control must depend on management—there is no other answer to "clover disease."

The measures recommended and adopted by farmers have undoubtedly met with much success, but it is probable, that the relative freedom from trouble during recent years may have been due, at least in part, to the effects of seasonal conditions. Ewe and lamb losses reported widely in 1955 have indicated that "good clover years" may still constitute a hazard in the areas of old-developed clover pastures, whereas clover dominance and its effects are still harder to avoid where clover is newly established.

"Clover disease" is relatively unimportant in most other parts of the continent where the environmental conditions rarely favour subterranean clover dominance.

It is evident, however, that in the "clover belt" of Western Australia special care is needed to defeat the undesirable effects of this plant which has enabled farmers to achieve spectacular increases in the stock-carrying capacity of their land and which, by its employment in ley-farming rotations has greatly enhanced the fertility of many properties in the sheep raising and cereal-growing areas.

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INSECT Pests AND THEIR CONTROL

By D. G. SHEDLEY, B.Sc. (Agric.), Entomologist

APPLE CURCULIO

Preliminary Report Of An Experiment

THE damage caused by the apple weevil or apple curculio (Otiorrhynchus cribricollis Gylh) takes several forms, the most apparent being marginal leaf damage. However, the bark chewing habit probably has a more direct effect on yield for it may cause ring-barking of the main leaders and growing shoots with their consequent die-back and the prevention of full development of immature fruit. The larvae or grub forms may also cause some root injury.

In conjunction with experiments being carried out to test the efficiency of various insecticides for the control of the beetle, careful studies of its habits and life history are being made.

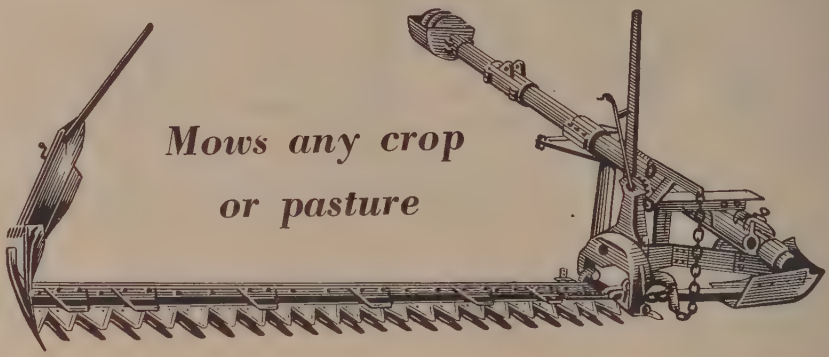
Two methods of insecticide application were employed in the 1955-56 experiment at Donnybrook. Dieldrin and B.H.C. (Gammexane) were applied as butt sprays, and dieldrin, lindane, methoxychlor, arsenate of lead and malathion were used as foliage sprays. Four hundred and eighty trees were included in the main experiment besides a number of trees in small areas which were used for trials. The two butt treatments (0.5 per cent. dieldrin and 0.5 per cent. B.H.C. gamma isomer) and the dieldrin foliage spray (0.05 per cent.) gave the best control. Of the additional insecticides used in the trials aldrin showed the most promise.

The effect of the treatments on other pests (bryobia mite, apple leafhopper, San Jose' scale, etc.) is being carefully observed, as application of insecticides for one pest have, on some occasions allowed others to increase. This is due to the toxicity of the material to some natural parasites and predators.

Although no evidence has been obtained on the experimental site, dieldrin cover sprays on other orchards have apparently resulted in a build-up of bryobia mite numbers. For this reason it is anticipated that further work will concentrate mainly on butt applications of insecticides.

For the orchardist wishing to control apple weevil, results of this experiment indicate that ½ per cent. dieldrin or ½ per cent. gamma isomer B.H.C. (1 part of 15 per cent. or two parts of 7 per cent. to 30 parts of water) should prove very effective when applied to the butts of trees in early December using about 1 quart per tree.

Experiments will be continued in the coming season to determine the most economical rates of application and to test other new insecticides.



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Book Review.

THE WHEAT INDUSTRY IN AUSTRALIA

TWO outstanding scientists with wide experience of wheatgrowing have collaborated in the authorship of a book "The Wheat Industry in Australia" which covers a wide field of research in a manner that is interesting to layman and scientist alike. They are A. R. Callaghan, C.M.G., D.Phil., B.Sc. (Oxon), B.Sc. Agr. (Sydney), the present Director of Agriculture, South Australia, and A. J. Millington, D.Sc. (Agr.), Reader in Agronomy at the University of Western Australia.

Dr. Callaghan was a Rhodes Scholar from Sydney University who became Principal of Roseworthy Agricultural College at the age of 27 and held that position until 1949 when he became Director of Agriculture for South Australia.

Dr. Millington is well known to most wheatbelt farmers in Western Australia. He joined the W.A. Department of Agriculture in 1934 and as Plant Geneticist played an important role in our wheat-breeding and flax-breeding work. He is at present engaged in the breeding of legumes which, it is hoped, will permit the extension of ley-farming methods to the lower-rainfall areas.

"The Wheat Industry in Australia" is not a textbook on wheat-growing—the authors rightly concluded that most of the farmers engaged in wheatgrowing today are well catered for in the respect of technical advice—and in any case the wheatgrowing techniques vary so widely from State to State, district to district and even farm to farm, and paddock to paddock that it would not be possible to do more than generalise.

Instead, they have given a very comprehensive picture of the industry and all its ramifications.

As they point out, the wheat industry in Australia is a new industry that is based on new land, new varieties, and new machinery—an industry that even today seldom has more than three generations of experience behind it.

Many of the current farm practices have had to be developed here on the spot to suit Australian conditions. For instance we had to breed our own wheats when we found that the Old World did not have the varieties we needed.

We developed the stump-jump plough and the stripper harvester—our unorthodox bulk-handling methods here in Western Australia provide another example of local initiative—so altogether we can feel proud to know that in terms of efficiency and economic stability, our wheat industry compares very favourably with that of the major wheat exporting countries.

When one comes to deal with this book in the form of a review, it is really amazing to discover how much it contains. There is a lot of very interesting historical information covering many phases of the industry and the book commences with a study of the rainfall characteristics of the Australian wheatgrowing areas and of their special types of soils.

There are chapters on soil structure and others on soil nitrogen. Our phosphate deficiencies and the all-important superphosphate industry are dealt with in detail and other chapters are devoted to the farming methods used in dealing with different types of wheatgrowing soils. Throughout the book, the emphasis is on "farming for the future"—the establishment of a system of permanent agriculture that will increase rather than deplete the fertility of the soil.

The growth of the wheat plant is described in detail and there is some very interesting information on wheat-breeding and on those men such as William Farrer and his colleagues who played their vitally important parts in the purposeful breeding of Australian wheat varieties.

The evolution of our farm implements—the part played by R. B. Smith in the development of the stump-jump plough; Ridley and Bull in the development of the stripper and H. V. McKay in the development of the harvester—all make interesting reading.

The F.A.Q. System; bulk-handling in Australia; farm economics; Australian wheat marketing and the part that our Australian wheat plays in world trade are other subjects included in this very comprehensive study of an important industry.

"The Wheat Industry in Australia" is priced at 63s. It is a book that will be of interest to the farmer, the scientific worker, or the student of agriculture. It is one of the Angus & Robertson publications and is attractively bound and well illustrated with over 280 illustrations, a coloured plate and a coloured map.—J.M.

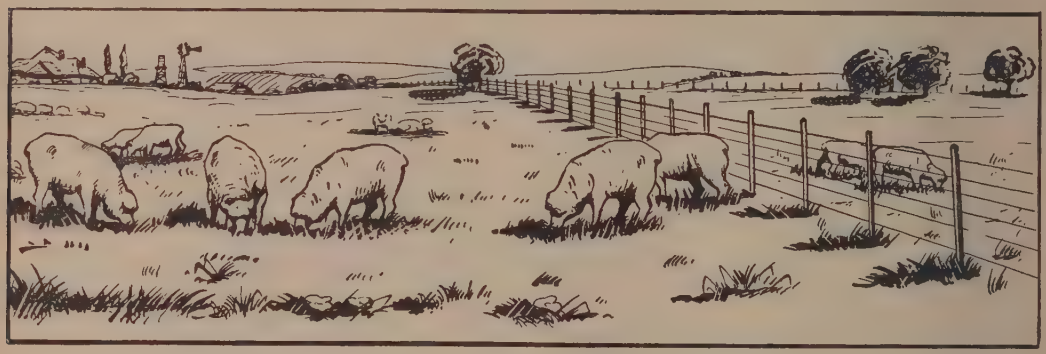

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Fig. 1.—Left: 8-year-old Jonathan on MM106 (Semi-Dwarfing). Right: 8-year-old Jonathan MM111 (Vigorous).
Photo—East Malling Research Station.

ENGLISH FRUIT TREE ROOTSTOCKS

By J. CRIPPS, B.Sc. (Hort.), Horticultural Adviser.

THE present-day fruit tree consists of two interdependent parts—the stock or root system and the scion or above ground portion. The scion naturally gains most prominence, as it is the part of the tree with which the grower is mainly concerned in orchard management and also the portion which provides him with his income. Nevertheless, the rootstock can exert a profound influence on tree performance. For instance, such factors as root anchorage, root penetration, drought resistance, resistance to pests and diseases, susceptibility to mineral deficiencies, growth characteristics of the tree and its ultimate size, its time of flowering, setting, fruit size and colour, period of ripening and the quality of the fruit can all be affected by the choice of rootstocks.

APPLE ROOTSTOCKS

In view of the profound influence of rootstocks on tree performance, fruit growers may be interested in developments in this field in England.

Some 35 years ago, work was commenced at the East Malling Research Station to develop rootstocks of known characteristics. This was occasioned by the unsatisfactory position which existed prior to this time, when only two stocks were recognised, namely Crab and Paradise. Crab was only suitable for very large trees grown in grass, such as cider varieties, and both it and Paradise showed considerable variation in vigour. To clarify the position, Paradise stocks collected from nurserymen all over Europe were grown at East Malling and segregated according to vigour. Eventually it was found that the so-called Paradise stock could be separated into no less than sixteeen distinct types, varying widely in characters and these were numbered M I to M XVI. These differences also showed in the vigour of the scion varieties worked on them. For instance, trees worked on the vigorous stock grew almost three times as large as those on the most dwarfing.

This original range of Malling rootstocks are, however, all susceptible to woolly aphid attack and may therefore not be acceptable here, but they form the basis of later ranges of rootstocks and will be described for the sake of continuity. They have been adopted widely in Europe

Fig. 2.—8-year-old Jonathan on MM115 (Very Vigorous). Photo—East Malling Research Station.

and introduced into North America where some of them are becoming popular. The most satisfactory members of the series are as follows:—

M IX.—This produces very small trees which require staking, particularly on poor soils. It is used for "filler" trees between permanent plantings but in one well-known orchard on rich soil in Hampshire, England, where rainfall is fairly high, the "permanent" planting has been removed and the filler trees on this stock left to form a highly productive orchard. M IX is an ideal stock for small trees for the garden, e.g. dwarf pyramids and cordons.

M VII.—A semi-vigorous rootstock which is said to be susceptible to Crown Gall. Although not widely planted, where used it has given good results.

M IV.—This stock is interesting since of the original series it gives rise to the heaviest cropping trees, but since its anchorage is very poor it is seldom employed.

M II.—By contrast, M II is a well anchored stock. Seventy-five per cent. of English commercial apple plantings are on this stock and varieties budded on it are fairly vigorous, growing steadily and persistently until they reach a considerable age under good management. Stoolbeds of M II produce up to 60,000 stocks per acre annually.

M I.—M I is similar to M II in vigour, but does not thrive under dry conditions. It has however found favour in the United States.

M XII.—This is a very vigorous rootstock and trees on it take longer to come into bearing except perhaps on poor soil. It is deep rooted, superbly anchored and said to be "suitable for climates of abundant sunshine where fruit bud formation is at a high level" and might therefore give rise to an excellent stock if crossed with Northern Spy to add resistance to woolly aphid to its virtues.

M XVI.—M XVI is very susceptible to woolly aphid attack and tends to grow late into the autumn, two disadvantages under local conditions, but it propagates well and produces vigorous trees which commence to crop fairly early in their lives.

Most of the stocks described above have disadvantages—some more than others. M II probably has the least and has proved very reliable.

Subsequently a series of four stocks was produced at the John Innes Research Station at Merton and these are known as Merton 778, 779, 789 and 793. All are crosses between Malling II and Northern Spy and are woolly aphid resistant.

None of the stocks which bear the prefix "Merton" is dwarfing and they range in vigour from moderately to very vigorous. Number 779 was not included in the original trial in England using Lane's Prince Albert as a scion variety, where of the remainder 789 was found to be the most vigorous, followed by 778 and 793 in that order. Measurements of weight of crop produced placed the three stocks in the same order, but 789 was found to have a lower ratio of blossom buds to new wood growth than the other members of the series.

All four were, however, included in a trial using Dougherty as the scion variety

Fig. 3.—Dougherty on Merton 779.
Photo—J. W. Endt.

carried out by the New Zealand Department of Agriculture but all trees on 789 were affected by collar rot and figures for growth and cropping relating to these cannot be considered valid. Merton 799 was found to be the most vigorous, followed by 778 and 793.

Under New Zealand conditions both 779 and 793 cropped heavily and seemed to be the outstanding members of the series, the former for the production of large trees, while scions on the latter showed only moderate vigour.

In 1928 an extensive breeding programme was commenced at East Malling Research Station with a view to obtaining an improved series of rootstocks resistant to woolly aphid attack.

Northern Spy was used as one parent with the intention of conferring woolly aphid resistance, and crosses were made with the various Malling rootstocks. The John Innes Research Station, then enduring the "smog" at Merton near London, was called in to aid East Malling in the work and altogether over 3,500 seedlings were bred. All were tested for susceptibility to woolly aphid and many eliminated on this count, while others were discarded, due to their low powers of reproduction, poor root systems and other undesirable qualities, thus substantially reducing the numbers to be tested in the field. It is notable that the majority of the recommended members of this series are crosses between Northern Spy and Malling II, the best of the original English series.

Finally 15 resistant stocks known as Malling-Merton and numbered MM 101 to MM 115 were selected and described. These all progagated readily by the stooling method. A further field trial was carried out using scions in selected varieties to compare them with rootstocks of the

Fig. 4.—Dougherty on Merton 793.
Photo—J. W. Endt.

Fig. 5.—Dougherty on Northern Spy No. 1.
Photo—J. W. Endt.

Malling series as well as Northern Spy. The trees were pruned by the regulated method, which merely involves the thinning out of overcrowded wood, to induce early cropping. Shoot growth, trunk girth, and later, yields were measured.

The three scion varieties chosen were Cox's Orange Pippin, Ellison's Orange and Jonathan. The first-named is of course the standard English dessert apple, but the last is of greater interest since it is one of the very few apple varieties having an almost world wide distribution, being grown in America, England (where it is known as Bowden's seedling), Europe and Australia. It is, however, a late variety in countries with a temperate climate such as England. It is interesting to note that there was little difference in the reaction of the three varieties to the new rootstocks which would suggest that other scion varieties might react similarly.

Generally the Malling-Merton stocks are much better anchored than the original Malling series and give rise to more precocious trees than do their predecessors. Furthermore, the scion varieties used in the trials yielded as heavy or heavier crops compared with those budded on to the earlier series of stocks. Trees on MM 104 gave the heaviest crops and are described as semi-vigorous, being comparable in that respect to trees on M IV. MM 106 represents an improvement on M VIII. MM 109 is a vigorous drought resistant stock, trees on which withstood the very dry summers of 1947 and 1949 better than those of Northern Spy. MM 111 is similar in many respects to M II but gave slightly heavier crops and M XXV, although not woolly aphid resistant is recommended as a very vigorous rootstock to replace M XVI. The stocks listed above are those passed as suitable for distribution to nurserymen in England. For local use, where woolly aphid resistance is desirable, MM 115 may be more suitable than M XXV; it appears to be a vigorous stock which is satisfactory in all respects.

The parentage of the Malling-Merton stocks mentioned is as follows:—

MM 104 Malling II crossed with Northern Spy.

MM 106 Malling I crossed with Northern Spy.

MM 109 Malling II crossed with Northern Spy.

MM 111 Merton 793 (Malling II x Northern Spy) crossed with Northern Spy.

MM 115 Malling II crossed with Northern Spy.

M XXV Malling II crossed with Northern Spy.

In the field trials conducted in England one planting was on a soil described as sandy loam with loam with gravel and the other on a loamy soil. The actual mean total yield per tree in pounds of the three scion varieties for the period 1948 to 1952 is given in the table below. Various members of the original Malling series of stocks as well as Northern Spy and Ivory's Double Vigour, a New Zealand stock, were included for the sake of comparison.

Fig. 6.—Left: 12-year-old Cambridge Gage plum on Common Plum Stock (Semi-Dwarfing). Right: 12-year-old Cambridge Gage plum on Myrobalan B (Very Vigorous).
Photo—East Malling Research Station.

Rootstock.	Yield on Loamy Soil.	Yield on Sandy Soil.
MM 101	114.5	61.8
MM 102	115.0	36.6
MM 103	166.8	71.9
MM 104	196.3	69.4
MM 105	133.0	67.9
MM 106	127.9	51.3
M IV	172.8	73.3
M VII	134.1	61.9
M IX	66.4	31.1
Northern Spy	166.3	50.8
MM 107	91.3	59.2
MM 108	133.9	33.0
MM 109	146.7	82,8
MM 110	137.0	83.9
MM 111	153.1	69.5
MM 112	120.2	55.7
MM 113	143.4	68.5
MM 114	134.1	51.2
MM 115	170.1	63.6
Ivory's Double Vigor	192.6	66.6
M I	105.9	37.5
M II	109.2	55.6
M IV	193.5	67.9
M XVI	190.0	57.1
M XXV	158.0	66.8

The important fact which emerges from this table is that Northern Spy cropped well (though not as well as MM 104 or MM 115) on the better soil where moisture stress was of comparatively minor importance, but on the relatively poor sandy soil where it was subjected to drought conditions in 1947 and 1949, most of the Malling-Merton stocks surpassed it in productivity.

MM 109 gave a yield of 63 per cent. greater, according to the figures published above, than Northern Spy which indicated that the latter may not be the ideal stock for under conditions of summer drought.

These stocks have been selected with an eye to their ease of propagation by means of stooling, which is the standard method of pome rootstock propagation in use in Europe. Stoolbeds should produce approximately 30,000 stocks per acre per annum. Stocks are not raised by every nursery, but are usually supplied by a few firms in England and Holland, which mass produce them. Rootgrafting is never practised, for scion rooting must be prevented at all costs since the stock must be allowed to exert its full influence on the scion variety.

PEAR ROOTSTOCK

Pears grown commercially in England are in the main budded on Quince A, the most vigorous of a set of three semi-dwarfing quince rootstocks (Quince A, B and C). These were selected at East Malling, and form trees similar in size to apples on Malling II, that is suitable for planting 24ft. apart.

PLUM ROOTSTOCK

Various plum rootstock have been collected and classified according to vigour by East Malling and of these, three are worth mentioning, viz.:

Myrobolan B, which is commonly used for cooking plums in England and produces vigorous trees. It is easy to layer and strikes readily from hardwood cuttings.

Brompton.—This stock is preferred for some high quality dessert plums and for peaches and nectarines on heavy "wet" soils where seedling peach stock tends to die out. It is also used for apricots and is comparable in vigour to Myrobolan B but does not propagate quite so readily by layering.

St. Julian A.—Until recently only one semi-vigorous rootstock, Common Mussel, was available for plums, but this stock tends to sucker profusely and to dry out in the budding season. Moreover, it does not layer well although it can be propagated in quantity by means of root cuttings. St. Julian A, however, does not sucker and layers well. It is compatible with all plum and apricot varieties and gives rise to trees of medium vigour which come into bearing early.

All the deciduous rootstocks described have been developed as the result of painstaking investigations at the East Malling and John Innes Research Stations. Their findings of course apply to conditions in England, but with the wide range of variation in vigour and tree performance exhibited by the various stocks, particularly apple stocks, there is little doubt that some at least would be suited to local conditions.

Arrangements are being made to introduce a small quantity of apple rootstocks in the coming season and these will be subsequently tested at the Horticultural Research Station, Stoneville.

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VEGETABLE FIELD DAY

Gascoyne Research Station

AN interesting field day was held at the Gascoyne Research Station on September 26. Mr. K. O'Connor, Vegetable Inspector of the Metropolitan Market Trust, had just arrived at Carnarvon by arrangement with the Department, to put in a week among vegetable growers advising upon vegetable marketing conditions and methods of presenting produce for sale.

The meeting was called to introduce Mr. O'Connor to growers, and at the same time to give growers an opportunity of inspecting trials under way on the research station.

In his opening address Mr. Nunn, Officer-in-Charge, North West Branch, made reference to the several visits made during the year by specialist officers from Perth, and expressed gratification with the vigorous way the new team of advisers were approaching their duties at Carnarvon.

He reviewed the trials under way, and urged confidence, cooperation and support for the Departmental group comprising: Regional Adviser H. Suijdendorp, Agricultural Advisers J. A. Lawson and R. Rees, Station Manager R. C. Nailard and Technician R. Veen, who, he said, were working with energy and a desire to make a real study of their work, and above all a unanimity and a willingness to cooperate with each other, which had not been so apparent under earlier combinations.

An inspection was made of trials under way with bananas, avocados, mangos, cover crops and vegetables, with brief addresses in the field, followed by a talk by Mr. Lawson in the packing shed, on the vegetable trial programme and indications obtained from the season's trials.

Vegetable trials were essentially of an exploratory nature, with small sowings of a great many varieties made periodically throughout the season for the several appropriate vegetable lines. Such plantings were essentially tiny in area to make the coverage possible, and of course a percentage of them had to fail in demonstration of unsuitable varieties and unsuitable planting times. For this reason it has not been at any time possible to have the range of vegetables under trial on display. The information got together however throughout the season, from systematic and multiple small plantings, has been considerable. Mr. Lawson presented this in interesting fashion.

Outstanding among the results was the story of onion plantings. Here the onion variety which Mr. Arthur Gardiner has developed over the years at Fitzroy Crossing, in the Kimberley Division, eclipsed all commercial varieties, and bulbs on show from January and February plantings and available for marketing in the present period of annual shortage, were described by Mr. O'Connor, as far and away superior to any onions now available in Perth from interstate and overseas sources.

Mr. O'Connor's address on marketing matters brought a host of questions from growers obviously keen to make something of the new lines suggsted to them.

A meeting which was, in the first instance, organised in rather a small way for the purpose of introducing Mr. O'Connor, developed into what was perhaps the best field day, and the most representative gathering of growers, ever organised by the Department of Agriculture at Carnarvon.

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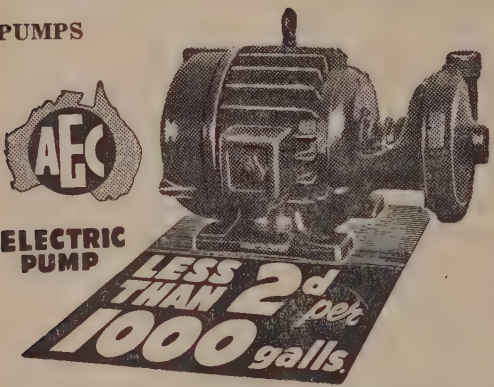

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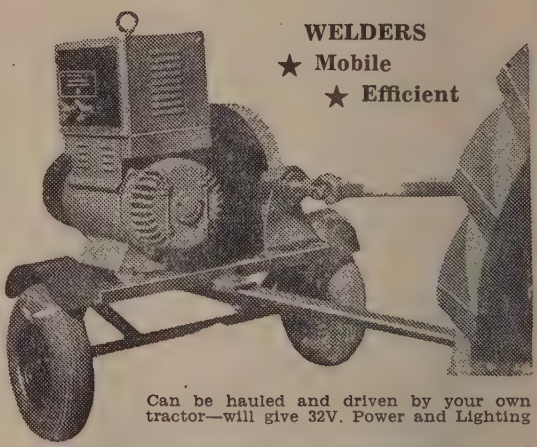

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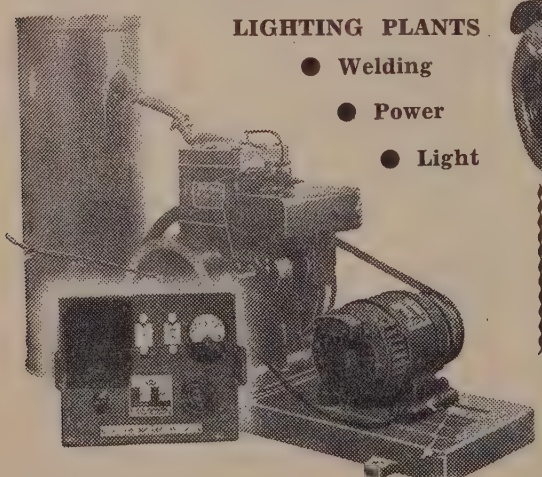

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SUDAN GRASS IS DROUGHT RESISTANT

By F. E. RYAN, B.Sc. (Agric.),
Agrostologist

Fig. 1.—Sudan grass at Waroona. Note the excellent regrowth after grazing (foreground).

WHILE maize and fodder sorghums are recommended for green fodder in dairying areas, the most suitable plants for summer grazing are Sudan grass and Japanese millet. Both can be sown on the majority of soils occurring in the dairying areas, providing ploughing is commenced sufficiently early in the spring. If sown in October or November, either of these plants will provide grazing for stock during January and February and if soil moisture supplies are adequate, will continue growth during March and April.

Sudan grass is the more popular of the two, but the choice between them depends on individual preference. Generally, Japanese millet will give a bulk of fodder if not severely grazed, while Sudan grass is reputed to recover better after grazing. During the 1954-55 and 1955-56 summer seasons, trials were carried out at Denmark Research Station to compare the growth of these two plants and also to compare them with sweet Sudan grass which has recently become available from Queensland.

TRIAL IN 1954-55

The summer season at Denmark during 1954-55 was mild with a dry period in January and February and heavy falls of rain in March. The three species, commercial Sudan grass, Japanese millet and sweet Sudan grass were sown in replicated plots and grazed at four to five weekly intervals. Four grazings were obtained in January, February, March and April.

Commercial Sudan grass produced the greatest amount of fodder, but not significantly more than Japanese millet. The Sudan grass made better early growth and was much more productive in April after three grazings had been obtained.

The millet produced more bulk at the second grazing in February, but then declined relative to the Sudan grass at the last two grazings.

Sweet Sudan grass was the least productive of the three, but was able to recover well after three grazings and was more productive in April than the Japanese millet. The air-dry yields for this experiment are shown in the following table:—

Denmark Research Station.

SUDAN GRASS AND JAPANESE MILLET GRAZING EXPERIMENT, 1954–55.

Average Air Dry Yields.

Species and Varieties.	1st Cut, 18–1–55.	2nd Cut, 22–2–55.	3rd Cut, 21–3–55.	4th Cut, 28–4–55.	Combined Grazing Cuts.	
	Cwts./acre.	Cwts./acre.	Cwts./acre.	Cwts./acre.	Cwts./acre.	Percentage of Control.
Commercial Sudan Grass	13·97	8·17	10·20	5·38	37·72	100
Sweet Sudan Grass	7·20	7·67	7·92	4·17	26·96	71
Japanese Millet	10·17	12·90	8·20	1·66	32·93	87

TRIAL IN 1955-56

The experiment was repeated during 1955-56. The season during the last summer was very different with hot dry conditions during January and February, during which the plants were affected by drought conditions. 290 points of rain were recorded for March and this improved growth considerably. Both Sudan grass and Japanese millet made reasonably good growth early in the season, but because of the dry conditions this was considerably less than had been obtained in the previous year. Sweet Sudan grass was the least productive of the three. At the second cut in February, commercial Sudan grass was found to be more successful under the drought conditions than the other two and its recovery in March following the rains was very much better than either the Japanese millet or the sweet Sudan grass. The combined yield from the three grazings proved Sudan grass to be superior to Japanese millet and both were more productive than sweet Sudan grass. These results are shown in the following table.

Fig. 2.—A Sudan grass crop in the Bassendean area.

Denmark Research Station.

SUDAN GRASS AND JAPANESE MILLET GRAZING EXPERIMENT, 1955–56.

Average Air Dry Yields.

Crop and Variety.	1st Cut, 18–1–56.	2nd Cut, 20–2–56.	3rd Cut, 25–3–56.	Combined Cuts.	
	Cwts./acre.	Cwts./acre.	Cwts./acre.	Cwts./acre.	Percentage of Control.
Commercial Sudan Grass	5·30	3·12	7·75	16·17	100
Japanese Millet, Commercial	5·90	2·32	3·45	11·67	72
Sweet Sudan Grass, SS6	2·76	2·24	4·24	9·24	57

CONCLUSION

In these trials Sudan grass was shown to be more drought-resistant than either Japanese millet or sweet Sudan grass and in the milder season of 1954-55, it was more productive than either of the other two varieties. In a normal season, Sudan grass is just as productive as Japanese millet and more productive than sweet Sudan grass (SS6) whilst in a dry season, Sudan grass was shown to be much more drought-resistant than Japanese millet and more productive than sweet Sudan grass.

These trials have also shown that Sudan grass can withstand grazing somewhat better than Japanese millet.

COMMENT

Insufficient attention has been given to growing of summer crops for grazing on dairy farms. They can assist in lengthening the lactation period and assisting in production of more butterfat per cow and greater annual output from the farm.

In choosing a suitable site, best results can be expected on soils which retain their moisture throughout the summer months, or where irrigation can be used and on these areas Japanese millet or Sudan grass may be used, as both are capable of giving very high yields of green material under these conditions.

On soils which are unable to retain their moisture throughout the whole of the summer, early spring ploughing will help to conserve moisture, which is available to the crop later in the year. For such a site Sudan grass is more drought-resistant and will respond to any summer rains which fall. The area which can be sown with Sudan grass is thus much greater than that suitable for Japanese millet.

ACKNOWLEDGMENT

I wish to thank the Manager of the Denmark Research Station, Mr. V. Weston and his assistant Mr. A. James, who carried out the work on these trials.

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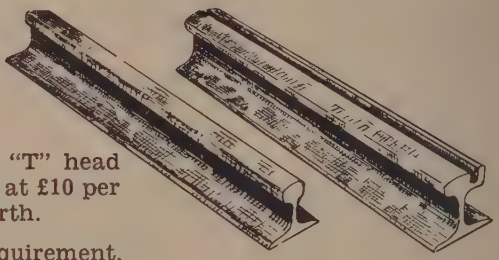

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Fig. 1.—Spraying a paper-bark swamp on the Swan River foreshore to eradicate Argentine ants

THE ERADICATION OF INSECT PESTS

Some observations on the Argentine Ant Campaign in Western Australia

TO an entomologist, and especially an economic entomologist, the word "eradication" means the destruction of all members of a species of insect in any particular area. It means the perfection of a project in the control of an economic insect pest.

Adapted from an address given before the Australian Institute of Agricultural Science (West Australian Branch), by the Retiring President (Mr. P. N. Forte, B.Sc., Agric.) on April 13, 1956.

Over a period of years the whole attitude to insect pest eradication has changed. There has always been a school of thought which maintained that it was impossible to find and kill the last insect of a species in any particular habitat or country.

However, with modern research methods and the newer lasting insecticides, it is evident that we can answer the question "Can insects be eradicated?" with a confident "Yes."

It is possible and desirable to wipe out destructive insects. When a new insect pest is introduced into a locality or country, it should be completely eradicated even if the expense involved is large, as this is usually much less than the economic loss which the pest can cause in subsequent years.

The success of a scheme for eradication of a pest depends on:—

(1) Devising an effective method of control. This can only be achieved by an appropriate research programme.

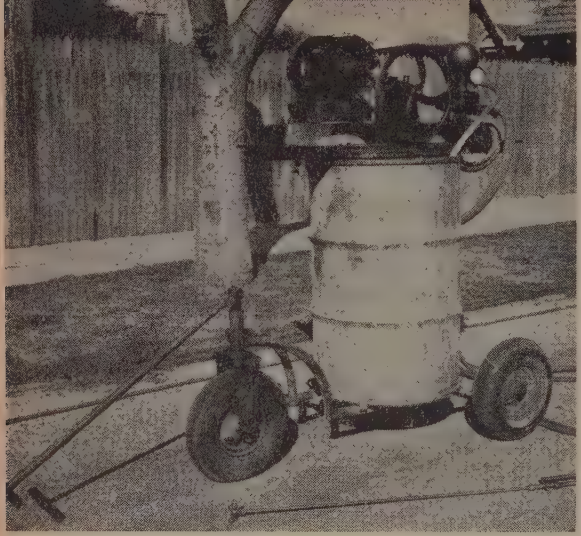

Fig. 2.—One of the mobile spraying units used in Argentine ant eradication.

(2) Implementation of a plan by legislation, i.e., once an effective scheme has been devised, it must have the backing of the Government and authority to operate. This is usually under an Act, e.g., Plant Diseases Act, Health Act.

(3) Co-operation of all States affected, so it may not spread back into the areas it has been eliminated from, i.e., implementation of Quarantine regulations.

(4) Full co-operation of the persons affected by the pest and the people conducting the campaign. This is usually assured by legislation but if people are willing to co-operate and legal action is not required, the scheme proceeds much more smoothly.

ERADICATION SUCCESSES

On this basis, successful eradication campaigns have been carried out in various places in the world.

For example, the Mediterranean fruit fly was completely eliminated from parts of 20 counties in Florida in about a year. The cost was 7,000,000 dollars but was considered well worth while, but it could not have been accomplished without the willing assistance of all concerned.

In other countries successful attempts have been made to eradicate insect pests from specified areas. These include such pests as the white garden snail, the citrus white fly, and the Colorado potato beetle.

The malaria-carrying mosquito (*Anopheles gambiae*), which caused 20,000 deaths in Brazil in 1938 and 130,000 deaths in Egypt in 1943, by transmitting this disease, has been reported eradicated from these areas. (The Governments of these countries were assisted financially by the Rockefeller Foundation in this enormous project.)

In Western Australia, we have had singular success in the eradication of 16 separate outbreaks of codling moth which has been of enormous benefit to the fruitgrowers and the State.

This has been achieved by discovering the introductions of the moth before the areas had become large and applying rigid control and quarantine measure to the orchards and surrounding areas.

THE ARGENTINE ANT

In Australia today, and particularly in Western Australia, we are in a position where we are able to contemplate the eradication of one of the most successful insect pests ever introduced into a country —the Argentine ant.

Since its arrival in Western Australia, it has, as in other States and countries of the world, exasperated housewives, caused gardeners to be constantly vigilant and reduced orchards to the stage where fruit production has become uneconomical.

When one stops to contemplate the area in this country which could become infested and calculate the money that people could spend annually on attempting control measures, it is staggering. I conservatively estimate it at £100,000 per annum on the present area of infestation in Western Australia.

THE HISTORY OF THE ANT IN AUSTRALIA

It was first recorded in Australia in Melbourne in 1939 and found then to be well established in several areas. The total area of infestation today in Victoria is approximately ten square miles.

Fig. 3.—"Gridding" a road with spray bands in 10ft. squares. All lawns and open spaces were treated in this manner

The next record was from Western Australia where in 1941 it was identified and found to be well established at Albany and Perth. Since then it has spread rapidly and by 1955 had reached a total area of approximately 42 square miles.

Finally it was recorded in Sydney in 1951 and found to be present in several areas. The total area discovered infested in New South Wales is approximately 3½ square miles.

There is no doubt that since its establishment in these parts of Australia the ant has found conditions ideal and it has spread rapidly.

It is a lover of moisture and would undoubtedly be able to infest all the towns in Australia, all the rivers, swamps and irrigated areas and this would include almost all of our orchard areas in Western Australia alone.

The possible area which could become infested in Australia runs into thousands of square miles.

ORIGIN AND SPREAD

The Argentine ant was first named from specimens of the species collected from Buenos Aires, Argentina, in 1868. But its country of origin is almost certainly Brazil. From there it has been recorded to have been transported in shipments of coffee to New Orleans in North America, and it was first established there by this method and for a while was called the "New Orleans ant."

It seems probable that the ant has been spread in this way to most countries of the world and we have a record of it being brought into Western Australia in a shipment of cacao beans from the Gold Coast in South Africa.

Fortunately it was only introduced into an infested area.

RATE OF SPREAD

The natural rate of spread of the Argentine ant is relatively slow, mainly because the queens do not have a nuptial flight and a new nest is established by a queen ant selecting a site with a number of workers and developing and expanding a nest there. In Western Australia it has been observed to be at the rate of about five acres a year from an individual colony under suitable conditions.

It is obvious that the rate of spread in Western Australia from its first record in 1941 to 10,000 acres in 1950 and 30,000 acres at the present time is due to artificial, as well as natural, spread. In Western Australia it uses such mediums as infested stable manure, pot plants, firewood, etc. These transportable materials provide ideal nesting sites for Argentine ants and transporting them from infested to uninfested areas has undoubtedly been responsible for the rapid expansion of the ant in the metropolitan area.

It should always be remembered that during its natural spread it has to encounter and eliminate the native ants in the area it invades. This it does, as I have witnessed, by engaging the native species in battle with an enormous number of workers while a further trail of Argentine ants raids the nest and carries off the developing ants therein so that the nest is destroyed.

DISTRIBUTION OF ARGENTINE ANTS

It is now firmly established in most countries in the world and in all is regarded as a serious household and agricultural pest.

Few people in Western Australia need to be reminded of this as they have heard or seen of Argentine ants raiding refrigerators, and people's beds and of protecting aphides and scale insects on garden plants and orchards to such good effect that the control of such insects is well nigh impossible.

BENEFICIAL ASPECTS

Only one benefit have I seen recorded that the Argentine ant had conferred and that was in the slum section of New Orleans in U.S.A. where it was credited with exterminating bed bugs and other vermin in the houses of the poor.

ATTEMPTS TO COMBAT THE ARGENTINE ANT

Poison Bait.

One of the earliest and most successful methods devised for combating the Argentine ant until the last ten years was by poison baits. The baits were made up with honey and sugar which was attractive to the ants, and contained arsenite of soda or thallium sulphate as the poison. The most successful formula was developed in U.S.A.

In 1924 in Mississippi the Plant Board exterminated Argentine ants in 1½ blocks by using a bait and this was the first town in the world where Argentine ants were eradicated. Subsequently, some other towns succeeded in the same way.

However, in many other places baits have been tried and where there is alternative food supply, it is often impossible to get the Argentine ants to touch a bait no matter how attractive it is made. This applies in Western Australia.

NO IMPORTANT NATURAL ENEMIES

There are no known important natural enemies of the Argentine ant and the attractive method of using biological control in handling this pest cannot be tried. Nor is there any information available of its economic status in the probable home of its origin—Brazil.

The commonest predator here in Western Australia would be the ant lion, an insect which in the immature stage constructs a conical hole in the sand so designed that ants falling into it cannot escape and are then eaten by the insect.

This then briefly was the state of our knowledge when Argentine ants were first discovered in Western Australia and, although the area was relatively small compared with that infested today, we did not have sufficiently good control measures to submit a plan for eradication of them.

This is the answer to those people who complain that the campaign we are conducting today should have been initiated when the ants were first found here.

However, some good results were obtained by people using baits and usually ants could be kept outside with them.

NEWER CONTROL MEASURES—RESEARCH ON ARGENTINE ANTS IN WESTERN AUSTRALIA

When DDT first became available in Western Australia it was tried against the Argentine ant (1945-46).

The results were almost as effective and spectacular as those obtained by using it in controlling mosquitoes and flies.

It was found that using a 2 per cent. concentration of DDT and spraying nesting sites, trees, and around the house foundations and boundary fence, it was possible to reduce ant activity to the minimum and prevent invasions of the house.

However, if an all-over cover spray was applied, ants could be eliminated for all intents and purposes from a household block. This method of application was more costly and subsequently "places sprayed" have been selected and reduced to a minimum after a further study of the ant's activity.

GOVERNMENT ACTION

So promising was DDT and so widespread had the ant become that by 1950 the Government had made funds available to spray 2 per cent. DDT on a large scale.

The control of these funds lay with the Public Health Department and the scheme was launched in co-operation with the Entomology Branch of the Department of Agriculture.

It was proposed to spray the whole of the infested area in Fremantle. This was done and, although the ants were not eliminated, their numbers were very considerably reduced. This was particularly noticeable when the present campaign embraced Fremantle where a survey (five years later) showed that the infested area had not spread appreciably since 1950, whereas in other areas it had.

NEW INSECTICIDES TRIED

At this time a new insecticide called chlordane become available in Australia and tests with it in New South Wales showed it to be very useful in controlling Argentine ants.

It was then tried experimentally in Western Australia and compared with DDT and mixtures of both at various strengths.

Although carefully planned, failure to use a treated buffer area around each plot to prevent ants entering from untreated or ineffectively treated areas permitted re-invasions and so affected the results of the experiment.

However, the general indications were that chlordane was superior to DDT

The failure to obtain significant differences between treatments in the first experiment resulted in a change in design. In addition, the observed quick kill and lasting qualities of 2 per cent. chlordane made it possible to change the aim of the experiments from control to eradication.

Chlordane kills the ants by direct contact when it is sprayed on them, but it also remains after spraying and ants crossing a sprayed area up to six months afterwards can obtain a lethal dose.

This also applies to insecticides, referred to later, and resulted in the modification of spraying plans.

In spraying, a power plant is used giving 150 lb. pressure and the spray lance is held about 8in. off the ground which gives a 6in. wide band of insecticide. When the liquid dries, the insecticide is left as a persistent band of material. The fact that the ant habitually forages for food in trails, makes it susceptible to treatment with a persistent insecticide.

PLACES TO SPRAY

The method of spraying was modified and the positions sprayed reduced to nesting sites and places where ants trail. These were the foundation walls of all buildings, the rails and posts of fences, the edges of paths and lawns and garden beds, the bases of shrubs, the trunks of trees up to 6ft., compost and rubbish heaps and grape vines, etc. The rest of the open area such as lawns and backyards was sprayed across at 10ft. intervals—at right angles—making it impossible for ants to trail anywhere without crossing a sprayed area.

The next experiment involved a complicated layout which used 146 household blocks totalling over 30 acres. The areas selected were in Shenton Park and Nedlands and the experiment was initiated in 1951.

The results of this experiment showed that after two applications, chlordane gave complete control of the Argentine ant and DDT was inferior.

ALDRIN, DIELDRIN AND CHLORDANE

Also during 1951, samples of aldrin and dieldrin—two new insecticides—were made available by Shell Chemical Coy. of Australia and were compared with chlordane in trial blocks of nine houses.

Used at high concentrations (2 per cent.) aldrin and dieldrin compared more than favourably with chlordane. In fact today—4½ years after spraying—the houses sprayed with 2 per cent. dieldrin are still free of ants and invading ants still die. This seems fantastic but the observations have been made by myself and an entomologist who lived in one of the houses for this period. What was happening was that ants invaded the fronts of household blocks almost nightly and could be seen trailing up to perhaps the front steps first thing in the morning. However, by the afternoon the trailing had ceased, and dead and dying ants were present where the trial had been.

This is because the ants take some hours to die after they have obtained a lethal dose of the insecticide.

The next logical step was to try aldrin and dieldrin at lower concentrations and to compare them with 2 per cent. chlordane which was now the yardstick for complete control. On a cost basis, it was desirable to use dieldrin no stronger than 1 per cent. as its price compared favourably with chlordane at 2 per cent.

Therefore in 1953 an experiment was designed and initiated using aldrin and dieldrin at ½ per cent. and 1 per cent. strengths and comparing them with 2 per cent. chlordane. Here again the layout was on a statistical basis allowing the results to be statistically analysed. In all, 108 household blocks totalling 20 acres were used in this experiment and the results showed that after 8 months ½ per cent. and 1 per cent. dieldrin and 2 per cent. chlordane had all eradicated the ants on the houses treated with them and, further, at the end of 12 months 1 per cent. dieldrin was still killing invading ants.

PRACTICAL SPRAYING ON A LARGE SCALE

At this stage of the work (1953) the practicability of repeating these experimental findings on a large scale was tested by spraying about a square mile in South Perth twice during the summer with 2 per cent. chlordane.

I think everyone has heard what a great success that was. There were no ants, flies, mosquitoes, cockroaches or fleas to be found in the area after spraying.

Besides proving that the ants could be eliminated on such a scale, very valuable information was obtained on operating costs, suitability of spray plants used, pitfalls in organising such a campaign and training spraying personnel.

The most important point from the research side was that it was shown that the cost of the insecticide made up half the cost of the campaign. Therefore, any saving in cost of this item—by buying it more cheaply or reducing the concentration without losing the efficiency to kill ants—was of paramount importance.

Therefore, the next step was to find the threshold value, or lowest concentration of dieldrin that would give eradication. Accordingly, an experiment was designed to test dieldrin at ½ per cent., ⅜ per cent., ¼ per cent. and ⅛ per cent. strength. This experiment involved the use of 112 household blocks covering 20 acres.

It was initiated in 1954 and sampled throughout the year. At the end of 15½ months the ½ per cent and ⅜ per cent. dieldrin treatments were still completely free of ants and this had been the case for ten months.

The experiment showed quite conclusively that the threshold value of dieldrin for eradication of Argentine ants is about ⅜ per cent., and ½ per cent. can be recommended as having a good safety margin and being much cheaper than 2 per cent. chlordane. It should be remembered that in any campaign the success

also depends on the spray operator. If he does not apply the spray carefully to all the recommended areas, then a hazard to the success of the campaign necessarily arises.

BASIC RESEARCH COMPLETED

At this stage then the basic research for a successful eradication campaign had been completed. The following information had been gained or worked out:—

(1) Experience in conducting large scale spraying.
(2) Perfection of mechanised equipment for such work.
(3) An effective and cheap method of application.
(4) An effective insecticide.
(5) An excellent research background for a scheme to be a success.

Finally, it has been demonstrated and is well known that the average householder is not able to cope with the Argentine ant problem even with these improved insecticides available to him.

THE ARGENTINE ANT ACT

In 1954 then, with this background, the Argentine Ant Act came into being. This gave a Committee the power to collect and spend £105,000 per annum for five years to attempt to rid the State of Argentine ants; a tremendous task, as the known area of infestation was approximately 42 square miles.

The Department of Agriculture was co-opted and entomologists began the job of surveying the areas proposed to be sprayed in the first year, viz., south of the Swan River. Other tasks were the purchase of plant and equipment and insecticides, the establishment of a central depot and training personnel.

All this was accomplished and a start was made in November, 1954.

By May, 1955, 7,200 acres had been treated, and this included all known infestations south of the Swan River and all country infestations except Albany, these included Bunbury, Harvey, Waroona, Yarloop, Wagerup, Manjimup, Katanning and Cranbrook. The immediate results were very satisfactory.

As too much time is lost through wet days and the ants are less active during the winter, the campaign was suspended until November, 1955, when the area north of the Swan River was tackled and a start was made at Albany.

To date this season over 11,500 acres have been treated in the Metropolitan Area and over 600 acres in the Albany area.

SUCCESS OF THE CAMPAIGN

A preliminary survey and check of householders' reports in last season's ½ per cent. dieldrin sprayed areas has been most encouraging and supported the experimental results.

Most reports have shown the ants concerned to be native species which have returned to the area. The subject of native species of ants living in association with Argentine ants in certain situations is an interesting one. But when Argentine ants are eliminated from an area, it is surprising how soon the native species reappear.

Where Argentine ants have survived, it is only as single nests which can be easily treated at little cost, and some of these have been killed without further treatment owing, I believe, to the persistency of dieldrin.

New areas of infestation have been found south of the River this season but these seem to be new introductions from north of the River. They are all small areas and can be treated simultaneously with the current year's programme.

SUBTERRANEAN CLOVER SEED

The recent certification of 35 tons of Dwalganup subterranean clover seed in the Narrogin area has brought the season's production (for all strains) to the record figure of 1,997 tons. The previous highest production figure was 1,616 tons in 1954.

Applications for the inspection of pastures with a view to certification next season are lower than for 1955—850 properties as compared with 1,200. About 450 of these are in the South-West with the remainder in the Great Southern and lower Midlands. The reduction follows over-production of Dwalganup and Yarloop seed last season when the price was the lowest for many years. Interest in the Mt. Barker or midseason strain has been well maintained.

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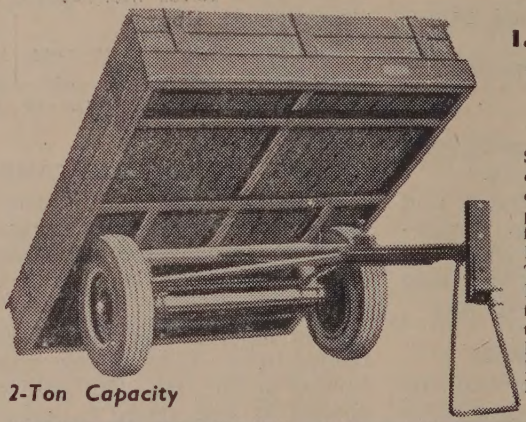

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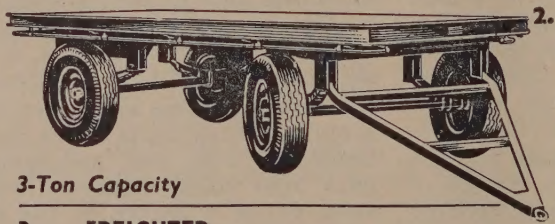

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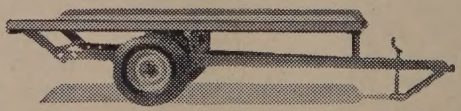

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BOOKS... *for FARMERS*

THE following books on agriculture have been added to the stock of the Library Board of Western Australia, and may be borrowed freely from any public library associated with the board, or consulted at the State Library of Western Australia.

GENERAL

THE CARE AND FEEDING OF GARDEN PLANTS, by D. G. Aldrich, [and others]. Washington (D.C.), 1954.

THE FIGHT FOR FOOD, by J. G. Cook. Lond., 1955.

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